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UTILITY PATENT APPLICATION TRANSMITTAL

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Attorney Docket No.	38237A
First Inventor	James D. BENNETT
Title	Data Collection Device having Visual Display of Feedback Indicators and Messages
Express Mail Label No.	EK 834 920 058 US

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APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO: Assistant Commissioner for Patents
Box Patent Application
Washington, DC 20231

1. ☐ Fee Transmittal Form (e.g., PTO/SB/17) *(Submit an original and a duplicate for fee processing)*
2. ☐ Applicant claims small entity status. See 37 CFR 1.27.
3. ☒ Specification [*Total Pages* 35] *(preferred arrangement set forth below)*
   - Descriptive title of the invention
   - Cross Reference to Related Applications
   - Statement Regarding Fed sponsored R & D
   - Reference to sequence listing, a table, or a computer program listing appendix
   - Background of the Invention
   - Brief Summary of the Invention
   - Brief Description of the Drawings *(if filed)*
   - Detailed Description
   - Claim(s)
   - Abstract of the Disclosure
4. ☒ Drawing(s) *(35 U.S.C. 113)* [*Total Sheets* 13]
5. Oath or Declaration [*Total Pages* ☐]
   a. ☐ Newly executed (original or copy)
   b. ☐ Copy from a prior application (37 CFR 1.63 (d)) *(for continuation/divisional with Box 17 completed)*
      i. ☐ DELETION OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).
6. ☐ Application Data Sheet. See 37 CFR 1.76
7. ☐ CD-ROM or CD-R in duplicate, large table or Computer Program *(Appendix)*
8. Nucleotide and/or Amino Acid Sequence Submission *(if applicable, all necessary)*
   a. ☐ Computer Readable Form (CRF)
   b. Specification Sequence Listing on:
      i. ☐ CD-ROM or CD-R (2 copies); or
      ii. ☐ paper
   c. ☐ Statements verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

9. ☐ Assignment Papers (cover sheet & document(s))
10. ☐ 37 CFR 3.73(b) Statement *(when there is an assignee)* ☐ Power of Attorney
11. ☐ English Translation Document *(if applicable)*
12. ☐ Information Disclosure Statement (IDS)/PTO-1449 ☐ Copies of IDS Citations
13. ☐ Preliminary Amendment
14. ☒ Return Receipt Postcard (MPEP 503) *(Should be specifically itemized)*
15. ☐ Certified Copy of Priority Document(s) *(if foreign priority is claimed)*
16. ☒ Other: Appendix A including pages 1-13 and FIGS 1,2,3A,3B,4,5, and 6.

17. If a CONTINUING APPLICATION, *check appropriate box, and supply the requisite information below and in a preliminary amendment, or in an Application Data Sheet under 37 CFR 1.76:*

☐ Continuation ☐ Divisional ☒ Continuation-in-part (CIP) of prior application No: 09 / 025,161

Prior application information *Examiner* Mr. D. Rodriguez *Group / Art Unit* 2876

For CONTINUATION OR DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 5b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

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Express Mail Label
No. EK 834 920 058 US

Attorney Docket
No. 38237A

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

TITLE

DATA COLLECTION DEVICE HAVING VISUAL DISPLAY OF FEEDBACK INDICATORS AND MESSAGES

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

TITLE: DATA COLLECTION DEVICE HAVING VISUAL DISPLAY OF FEEDBACK INDICATORS AND MESSAGES

SPECIFICATION

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application is a continuation-in-part of U.S. Application Serial No. 08/761,408 filed December 6, 1996, which itself is a continuation-in-part of U.S. Application Serial No. 60/008,425 filed December 8, 1995. Said applications are hereby incorporated herein by reference in their entirety.

BACKGROUND

1. Technical Field

The present invention relates generally to data collection devices; and, more specifically, to a portable code reader which in addition to, or instead of, traditional display means, incorporates an improved visual feedback system for interfacing with an operator.

2. Related Art

Prior hand-held portable data collection devices come in different shapes, sizes and weights. Typically, the smaller they are and the less they weigh, the more portable they are considered to be. Some hand-held portable data collection devices employ a laser for scanning coded images, while others employ a charge coupled device (CCD) based system with full illumination. Some of these devices are used to scan only one-dimensional (1D) coded images, while others can be employed to scan both 1D and two-dimensional (2D) coded and non-coded images.

Often the cost and size of a hand-held portable data collection device is determined by the number of features and the number of components implemented by the device. For example, a low cost barcode reader might include an optics assembly for illuminating and capturing an image of a barcode, processing circuitry for decoding the captured image, a buzzer or beeper and LEDs (Light Emitting Diodes) to signal successful or unsuccessful scanning events, a computing component for computations, and a memory for the storage of collected information. Although small in size, such data collection devices have several problems associated with their operation. They cannot convey more detailed information, such as the decoded information to an operator. Again, information regarding the unit itself, such as problems with the unit and the battery power levels cannot be easily conveyed to the operator. Although the LEDs may be used to convey some information to the operator, unless the operator is looking at the LED's any information conveyed via the LEDs is likely to be missed by the operator. Moreover, an operator who is color blind is likely to miss the information being conveyed via the LEDs. If an operator tries to look at the LEDs while trying to capture a target

coded image using the hand-held data collection device, the operator is likely to miss the target by moving his eyes away from the target. If a buzzer is employed to convey information to an operator, the noise made by the buzzer is often not heard by an operator.

High-cost hand-held portable data collection devices include extra features such as a display for displaying collected information and a small keyboard for data entry. These devices typically have a display mechanism attached to the top of the device to enable the operator to read information that is collected. For example, an LCD screen is often located on the top of bar code scanners that provides information to a user. One problem with the higher-cost data collection devices is their bigger size and weight due to the addition of a display and a keyboard, which makes them less portable than a smaller and lower cost one. Another problem is the higher power consumption due to these additional components. A further problem with such systems is that the user may not read the information displayed on the display mechanism while simultaneously aiming the device at a coded image. The placement of the display mechanism, on top of the device and facing the operator during the operation of the device, does not take into account the fact that the operator is typically looking at the target coded image and cannot simultaneously focus his eyes on the display. Thus, any information displayed during the operation of the device that can facilitate in the activity of reading coded images may be lost on the operator. If the operator tries to focus his eyes on the display to read the displayed information, the operator is likely to aim the data collection device away from the target coded image in doing so. Other problems described above with reference to low cost data collection devices are also likely to be experienced with these higher-cost

devices. Moreover, the power consumption of these higher-cost devices is likely to be a lot more than the lower-cost devices described above due to the addition of the display and a keyboard.

Another common problem faced by operators of hand-held data collection devices in large industrial environments is one of receiving messages from others in the work environment while operating a hand-held portable data collection device. Some of these operators carry a pager to receive messages or stay in touch with others. Others carry an RF communication device or a mobile telephone for communication with others. In such environments, the operators are not only required to carry a hand-held data collection device on their person but also on such associated communication devices. It is usually quite cumbersome to carry multiple devices all day long in work environments such as a warehouse, especially if the multiple devices are bulky.

Another problem typically faced by operators of hand-held data collection devices in noisy industrial environments is one of receiving audio messages announced over an audio system. Most messages announced over audio systems in noisy work environments are not heard by the intended recipients. Having a message communicated on their cellular phone or RF device, if an operator carries them around, is an option. However, a phone in noisy industrial environments is undesirable and costly, besides requiring the operator to carry an addition device.

Similarly, when an operator carries a pager for receiving paging messages, the operator will have to carry an additional device just to alert him of messages received or on the need to contact another individual. If the pager employs audio stimulus to alert an

operator of incoming calls or messages, such audio stimulus may be drowned by the ambient noise in noisy work environments.

Conventional code reading units also suffer from other problems related to the reading of coded images. For example, while trying to collect data from coded images, such as bar codes using a hand-held data collection device, an operator may be too close or too far from the coded image for the device to properly read and decipher the coded image. The operator receives no indication of such orientation problems. Thus, the operator repeatedly attempts the read operation without much success wasting portable battery power. Similar problems occur when the hand-held data collection device is in an off-center of skewed orientation. The operator is not aware of the problem and may repeat the reading process many times before completing a successful read.

SUMMARY OF THE INVENTION

In accordance with the present invention, during the operation of a data collection device, such as a hand-held bar code reader, visual feedback information is provided to the system operator indicating that the data collection device is too far, too close, to the left of, or to the right of the target coded image, without distracting the operator or hampering the data collection activity. The visual feedback indicator can be textual or non-textual, and can be positional or non-positional, and may be both one-dimensional and two-dimensional. Information not related to the scanning activity, such as messages received from external systems, such as paging systems, or other system generated messaging information is also visually displayed.

A data collection device is used with a target surface, where the data collection device includes: a light source that emits a beam of light, control circuitry operable in a first mode and a second mode, and an image disposed on the target source. The control circuitry assists the light source in capturing the image at the target surface in the first mode, and assists the light source in displaying at the target surface in the second mode information related to, or unrelated to, the image captured at the target surface in the first mode.

The data collection device incorporates novel and efficient scanning features while displaying the feedback information or messages. The visual feedback indicators are displayed by tracing a laser beam in specific beam patterns. The pre-calculated beam patterns for standard feedback indicators are stored in memory. For efficiency in scanning and to save on power consumption, only the required number of lines, pre-calculated for standard feedback indicators, are scanned with the laser beam. Several

different kinds of information are visually displayed. Both graphical and textual messages received over a wireless link during a scanning activity are displayed optically. System generated messages containing status information are also displayed.

In another embodiment, feedback indicators are visually displayed in conjunction with displays on a conventional display device such as an LCD screen.

Moreover, other aspects of the present invention will become apparent with further reference to the drawings, specification and claims which follow.

Brief Description of the Drawings

Fig. 1a is a perspective diagram of a hand-held portable data collection device in accordance with the present invention, showing a two dimensional (2D) coded image being scanned;

Fig. 1b is a perspective diagram of a hand-held portable data collection system of Fig. 1 showing a read completion feedback indicator;

Fig. 1c is a perspective diagram of a hand-held portable data collection system of Figs. 1a-b showing the display of a feedback indicator that directs the operator to move closer to the target image;

Fig. 1d is a perspective diagram of a data collection device indicating to an operator requisite adjustment information in graphical format for obtaining a successful reading of a coded image such as a bar code;

Fig. 1e is a perspective diagram of a hand-held portable data collection device in accordance with the present invention, showing an optical message being generated and displayed in textual form on a blank area of a box while an operator scans a coded image;

Fig. 2 is an exemplary schematic block diagram, of a hand-held portable data collection system, such as that of Figs. 1a-e, that employs the same illumination mechanism to scan coded images and to display feedback indicators;

Fig. 3a is a flow chart illustrating an exemplary operation of a data collection system in accordance with the present invention, such as those illustrated in Figs. 1a-2, where feedback indicators are displayed as necessary during the reading activity and messages are displayed when the reading activity is not being performed;

Fig. 3b is a flow chart describing an exemplary visual display operation utilizing optional scaling of text and graphics as well as optional word wrap of text;

Figs. 4a, 4c and 4e are exemplary scanned images received by three different scans, each corresponding to a different exemplary orientation of the hand-held scanning system with respect to a coded image being scanned, and Figs. 4b, 4d and 4f, respectively, are exemplary feedback indicators that are generated in response;

Fig. 5 is a perspective diagram of an exemplary glove shaped hand-held portable data collection device in accordance with the present invention that does not have room for a conventional LCD display at the top and relies on the generation of visual feedback indicators for communication with an operator;

Figs. 6a-6c depict exemplary feedback indicators and messages for a hand-held data collection system in accordance with the present invention when the data capture system is only capable of one dimensional scanning;

Figs. 7a-7e are exemplary animated feedback indicators and messages for a hand-held data collection system in accordance with the present invention which is only capable of one dimensional scanning; and

Fig. 8 is a diagrammatic representation of another embodiment of a hand-held portable data collection system that contains a plurality of LEDs for generating a scanning beam in accordance with the present invention, reading a one dimensional (1D) coded image.

Detailed Description

Fig. 1a is a perspective diagram of a hand-held portable data collection device 11, built in accordance with the present invention, showing a two dimensional (2D) coded image 25 being scanned. The hand-held portable data collection device 11 employs laser raster scanning to read 2D coded images. An operator (not shown) attempts to read coded images using the data collection device 11 by pointing it towards the coded target disposed on a target unit 23, such as the coded image 25 on a box, and activating scanning operations. The operator using the hand-held portable data collection device 11 is provided with feedback information, if necessary, by the data collection device 11 using visual feedback indicators that facilitates the coded image 25 scanning operation. Such feedback indicators are displayed on the target, unit such as a box, on which the coded image 25 is disposed. In addition, messages unrelated to the scanning activity, such as messages received from external systems or status messages generated by the hand-held portable data collection device 11, are also selectively displayed on the target unit or on a wall. To display such messages, the data collection device 11 employs the same circuitry used to scan coded images.

In particular, after attempting to aim the data collection device at the target 23, the operator initiates a reading attempt using the data collection device 11 in the same manner as can be found with conventional collection devices. For example, the collection device 11 may utilize a proximity detector, a gun-like trigger, or the keyboard to initiate a scanning attempt.

Aiming the data collection device 11 comprises attempting to: 1) center the scanning output on the target 23; 2) avoid skew between the device 11 and the target 23;

and 3) move the device 11 into reading range of the target 23. Feedback indicators are provided by the device 11 on the target 23, as and when necessary, to facilitate operator activities during the three steps enumerated above.

If a successful scanning event occurs, the device 11 provides a successful completion feedback indicator. In general, the device 11 provides a feedback in the form of feedback indicators, messages displayed on a display unit, and/or mechanical stimulus to the operator, informing the operator of problems with scanning the coded image 25 or deciphering it.

In one embodiment, the hand-held data collection device 11 has an optional display device 17 on the top, which may be a liquid crystal display (LCD) based display device. The location of this display device is influenced by the need to provide easy display during operation. A keypad 19 is optionally provided for data entry by the operator. The hand held data collection device 11 also includes an RF transceiver with an antenna 15. One of the buttons of the keypad 19 acts as a trigger mechanism to activate the scanning of a coded image. Optionally, a finger operated trigger mechanism, not shown in the diagram, may also be used for initiating the scanning of a coded image.

In general, the information that must be conveyed to the operator by the device 11 may or may not be related to the data collection operation. However, since the information provided to the operator must be easy to read during the normal operation of the data collection terminal, the device 11 provides such information using feedback indicators or messages displayed on the target unit 23. The display of feedback indicators and messages on the target 23 is often accompanied by similar displays on the display unit 17, which the operator may choose to view either during a scanning activity or later.

In addition, the feedback indicators or messages are provided employing the components that are also employed for the scanning of coded images by the data collection terminal.

The data collection device 11 is also capable of receiving messages from an external source over an RF transceiver (not shown) included in the data collection device 11. Such messages are selectively displayed using the display unit 17. On the receipt of a message from an external source, the data collection device 11 alerts an operator by a visual display of the received message or by an indication suggesting the receipt of a message. Since displaying a message on the hand-held data collection device 11, without prompting the operator to access it, is of limited use, the device 11 provides a visual indicator to prompt the operator to view the message. This ensures that the operator receives a prompt to read the messages.

In one exemplary embodiment of the present invention, various symbols are used as feedback indicators to convey information to an operator. For example, one feedback indicator may be an arrow pointing to the right that is displayed on the surface of a target indicating the need to aim the hand held device to the right of its currently aimed position. Optionally, such feedback information may also be provided on the display 17 located at an ergonomic position on top of the data collection device 11. Moreover, the feedback indicators may be optionally displayed only on the display 17, based on user preferences.

Additionally, the system 11 may also display information not related to scanning coded images, visually on a target surface. For example, the system 11 may display information related to the current status of the system or information related to the status

of the battery in the system. Another example is the display of messages received over the RF transceiver.

A light source such as a laser device is employed by the system 11 to generate a laser beam 21 and scan coded images. The light source employs typical laser raster scanning techniques to scan coded images. For drawing the feedback indicators with a laser beam, system 11 traces the beam in a specific pattern to generate visual displays of specific feedback indicators. In tracing the laser beam along the beam patterns, system 11 employs only the required number of horizontal scans instead of scanning over the entire range of lines. This efficient mode of scanning while displaying a feedback indicator saves power consumption and extends battery life.

The generation of non-textual feedback indicators is facilitated by creating a standard set of beam patterns for a standard set of indicators. For each of the feedback indicators in such a standard set, the associated beam patterns are pre-calculated and stored in a memory in the system 11. When these feedback indicators are to be drawn, the necessary pre-calculated beam patterns are accessed from memory and employed to generate the visual display.

The type of feedback indicators displayed is determined by the operator preferences and the capability of the system 11. For example, the operator preferences may indicate textual feedback indicators and messages, in which case all feedback indicators and messages are displayed using text. If, on the other hand, the operator preferences indicates non-textual feedback indicators and textual messages, the system 11 would generate them as necessary.

Fig. 1b is a perspective diagram of the hand-held portable data collection system of Fig. 1 showing a read completion feedback indicator 53. The read completion feedback indicator 53 is optically generated and displayed while a two dimensional (2D) coded image 51 is being scanned by an operator. To successfully scan the coded image 51 and decipher the coded image, the operator needs to adjust the position of the data collection device 11. In this diagram a feedback indicator 53, displaying a visual check mark, indicates the successful completion of the scanning activity by the operator.

Fig. 1c is a perspective diagram of the hand-held portable data collection system of Figs. 1a-b showing the display of a feedback indicator 33 that directs the operator to move closer to the target image 31. The feedback indicator 33 displayed is a "+" symbol to indicate the need to move the system 11 closer to the label 31.

During a scanning operation, an operator of the hand held data collection device 11 may position the system 11 too close to the label containing the coded image 31 or position it too far from the label 31. The operator may also aim the system 11 to the left of or to the right of the coded image 31 on the label on a target unit. An appropriate feedback indicator 33 is displayed to facilitate the adjustment of the position of the data collection device 11 by the operator.

The feedback indicators are generated by tracing an optical beam along scanning beam patterns employed by the system 11. Various beam patterns can be used to generate textual feedback indicators and textual messages, in addition to feedback indicators such as the "+" sign displayed.

FIG. 1d is a perspective diagram of the data collection device indicating to an operator requisite adjustment information in graphical format for obtaining a successful

reading of a coded image such as a bar code. Specifically, a hand-held portable data collection device 11, built in accordance with the present invention, scans a two dimensional (2D) coded image and displays a feedback indicator 101. The feedback indicator 101 recommends, to an operator, the need to position the system 11 to the right of its current position, for better aiming and effective scanning.

The activity of scanning a label containing a coded image, controlled by the system 11, typically illuminates only a small portion of the exposed area of a target unit such as a box that contains a coded image. The operator of the data collection device 11 may misalign the operational field of view with respect to a coded image 103 that is to be read, thus necessitating an adjustment in the position of the data collection device 11. The direction in which the data collection device 11 needs to be adjusted is detected by the data collection device 11 itself, based on collected data. The system 11 communicates the adjustment information to the operator by means of the feedback indicators 101 that are optically generated and displayed. A laser beam that is typically employed for scanning across a coded image 103, is also used to generate the feedback indicator 101. By the manipulation of the laser beam and making it trace a specific beam pattern, a feedback indicator 101 is generated and visually displayed. Optionally, two laser beam generators may be employed, one to scan coded images and the other to generate visual feedback indicators. The feedback indicator thus displayed will be visible to an operator without distracting the operator from his task of scanning coded images. Moreover, they can be used to convey information to the operator even when a display device such as a LCD screen is not available.

Fig. 1e is a perspective diagram of a hand-held portable data collection device 11, built in accordance with the present invention, showing an optical message 153 being generated and displayed in textual form on a blank area of a box while an operator scans a coded image 151. It indicates the ability of the data collection device 11 to display textual messages that the operator can clearly read, on a surface that is currently being scanned or about to be scanned. The textual message 153 that is displayed can be associated with information received by the hand-held data collection device 11 over an RF transceiver integrated into the device. Alternately, the textual message displayed may also be associated with internal information generated within the system 11 during the operation of the system.

Fig. 2 is an exemplary schematic block diagram, of a hand-held portable data collection system, such as that of Figs. 1a-e, that employs the same illumination mechanism to scan coded images and to display feedback indicators. A control circuitry 201 is responsible for coordinating the overall operation of the hand held system 11 of Fig. 1a. In this embodiment, the control circuitry 201 includes scan management circuitry 203 which coordinates the scanning activities. The scan management circuitry 203 scans a 2D coded image or a 1D coded image on a label by managing the operation of a scan drive circuitry 229, and a laser drive circuitry 209. The laser drive circuitry209 operates laser diode 263, under the influence of the scan drive circuitry 229.

The scan management circuitry 203, or in its absence, the control circuitry 201, identifies the number of lines of scanning to be performed when displaying a feedback indicator or a message. To display a feedback indicator or a message, appropriate beam patterns are identified by the control circuitry 201 and the generation of the optical

display is controlled by the scan management circuitry 203. The scan management circuitry 203 is responsible for operating the scanning activity so as to minimize the power consumed by the optical display generation activity. The power consumption is minimized by scanning only the required number of lines in the Y-axis during the generation of an optical display for a feedback indicator or message.

To initiate the scanning operation, the scan management circuitry 203 sends an enable signal to the scan drive circuitry 229 over a bus 235. The scan management circuitry 203 receives information on the current position of the Y-axis scan and the X-axis scan from the scan drive circuitry over the bus 235. It also sends a range select value to the scan drive circuitry 229, when scanning is to be performed to display a feedback indicator or message.

When the device of Fig. 2 is activated for scanning a coded image, the laser drive circuitry 209, under the control of the scan management circuitry 203, and with the scanning range information from the scan drive circuitry 229, causes the laser diode 263 to generate a laser beam and scan it across an operational field of view. In the preferred embodiment, the laser diode 263 is employed to generate a laser beam. Other laser generating devices may also be employed. The laser beam generated by the laser diode 263 may be controlled to scan or raster in both a vertical and a horizontal, orthogonal 2D scanning pattern. Thus, the pattern of the laser beam upon a surface, such as a surface containing a label with a coded image, may be controlled to create various visually readable patterns. In such an arrangement, visual indications may be communicated to the operator concerning the scanning process, as previously described in Figs. 1a-1e.

The laser drive circuitry 209 and the laser diode 263 are collectively referred to as the illuminator circuitry, as they are used for the illumination of coded images. One advantage of the present invention over prior systems is the use of the illuminator circuitry for the illumination of coded images as well as for the generation and display of feedback indicators.

A photo detector 221 receives the laser signals after they are reflected from the coded images, when the coded images are scanned by a laser beam generated by the laser diode 263. The detection interface circuitry 223 processes the signals received by the photo detector 221 and analyzes them to detect the presence of a coded image. If a coded image is detected, the detection interface circuitry 223 sends appropriate signals to the control circuitry 201 over the bus 235. It also sends information on the position of the coded image within the operational field of view. After the laser diode 263, under the control of the scanning management circuitry 203, has scanned a coded image, the laser diode 263 is then deactivated while the detection interface circuitry 223 and the control circuitry 201 processes the information received from the photo detector 221.

If the scan of the coded image is unsuccessful and the coded image cannot be properly deciphered by detection interface circuitry and the control circuitry 201, the control circuitry 201 initiates the display of a feedback indicator to request the adjustment of the position of the system 11 by the operator. The control circuitry 201 interacts with a memory 217 where it stores pre-calculated beam pattern information for the standard set of feedback indicators. The beam pattern associated with a feedback indicator is accessed from memory 217 when the feedback indicator is to be displayed. After viewing the feedback indicator displayed, the operator may readjust the position of the hand held data

collection device 11 in relation to the coded image such that the next attempt at reading the coded image would have a greater likelihood of success.

A keypad 215 can be employed by an operator of the hand held data collection device 11 of Fig. 1a to enter information into the system. Keypad/trigger interface circuitry 219, that is attached to the keypad / trigger by a link 253, is employed by the control circuitry 201 to control the entry of information from a keypad or trigger. The control circuitry 201 interacts with the keypad / trigger interface circuitry 219 over the bus 235.

A display 205 is used by the control circuitry 201 to display information that an operator can read. A display drive circuitry 207 provides an interface to the display 205. The control circuitry 201 communicates with the display drive circuitry 207 over the bus 235. The information displayed on the display 205 may also be simultaneously displayed visually on a target surface by the control circuitry 201 by generating and displaying a visual message or feedback indicator. The information may also be visually displayed as an icon or image, or communicated to the operator as an audio alarm via a buzzer 213.

The control circuitry 201 can be connected to other computers over a radio frequency (RF) link that can be established over a wireless transceiver 225. The wireless transceiver 225 receives information from external sources over the RF link using an antenna 227 and forwards them to the control circuitry over the bus 235. Messages and information received by the control circuitry 201 can be displayed using visual non-textual messages, textual, or a combination of non-textual and textual messages, so that the operator can view them.

The buzzer 213 can be used to alert the operator for various purposes. To provide vibrational and audio stimulus or feedback to an operator, the control circuitry 201 can activate the buzzer 213. An exemplary usage of the buzzer is the signal to alert the operator on operational problems with the laser diode 263.

Fig. 3a is a flow chart illustrating an exemplary operation of a data collection system built in accordance with the present invention, such as those illustrated in Figs. 1a-2, where feedback indicators are displayed as necessary during the reading activity and messages are displayed when the reading activity is not being performed. When the hand held system 11 is activated, the generation of visual patterns for feedback indicators is interspersed with the activity of reading for coded images. In one embodiment, while the activity of reading of coded images is being carried out, the feedback indicators are not displayed. Thus, these two activities are mutually exclusive. However, in another embodiment, the reading and display of feedback indicators is performed simultaneously, especially if the reading and the display of feedback indicators are executed by two different optical devices, for example by two different laser scanners.

A block 301 is the initialization point for the operation of the data collection system and the system rests at a block 303 when it is in an idle state. At block 303, the system also determines the need to display a message using the reading motion of the laser beam or the need to start reading a coded image. If a trigger is activated on the system, the trigger event 305 is received at the block 303. Later, if a coded image is to be read, the necessary activity of reading for coded images is initiated at a block 309. At a block 311, the system 11 determines if the coded image can be decoded. If the reading for the coded image is not successful due to the improper position or orientation of the

hand held system with respect to the coded image, the laser beam is then employed to generate visual optical feedback indicators or messages and to display them. The orientation of the hand-held system 11 of Fig. 1a and its offset from the coded image offset is identified at a block 313 and the necessary feedback indicator is identified at the block 313. The feedback indicator is then displayed at a block 315. The feedback indicator is optionally displayed on the LCD display screen. After the display of the feedback indicator, the system waits for a period, at a block 317, before returning to the block 309 where it attempts to initiate the reading of coded images again.

If, at the block 311, it is determined that the captured coded image can be decoded, then at the next block 319, the post processing of the coded image is initiated. Subsequently, at the next block 321, a display completion indicator is displayed visually using completion feedback indicators as previously described for Fig. 1b. Optionally, the associated feedback indicator is also displayed on the display 17. Later, at the next block 325, the data collection system waits for the release of the trigger by the operator before returning to the block 303.

When the system is at the block 303, it can receive an input 307 that indicates that incoming messages are to be delivered to the operator. At the block 303, if the system identifies the need to display a message, it determines if the system is currently reading a coded image at a block 325. If the system determines that a coded image is currently being read, it indicates a message pending signal to the operator at a block 327 and returns control to the block 303. The message pending signal can be created as an audio signal or as a vibration generated by a buzzer. Other kinds of signals may also be generated.

If, at the block 303, it is determined that a message is to be displayed, and at the block 325 it is determined that coded images are currently not being read, the message to be displayed is processed at a block 329. The message processing at the block 329 may involve formatting the message into a different format or translating the message into a different message. The processed message is then displayed onto the target surface at a block 331. Optionally, block 331 can also cause the same message to be displayed on the display device 17 located on top of the hand held system. After the display at the block 331, the system sets a timer to allow the operator to optionally acknowledge the receipt of the message displayed. At a block 333 the system 11 accepts any acknowledgment received from the operator, or the expiry of the timer period previously set, and then transfers control back to the idle state block 303.

Although, when the data collection system is being used to read a coded image, the message processing and display of messages is suspended until the reading of coded images is completed, in an alternate embodiment, the messages received during a reading activity may be queued up for subsequent access by an operator and the display of the messages may be deferred until further operator action. System generated messages, however, may be of a priority high enough to interrupt the reading activity, and may be displayed as soon as they are received.

Fig. 3b is a flow chart describing an exemplary visual display operation utilizing optional scaling of text and graphics as well as optional word wrap of text. The generation and display of a feedback indicator requires the identification of the feedback indicator and the manipulation of the laser beam to create a visual display for the feedback indicator. For a non-textual feedback indicator that belongs to a standard set,

the beam pattern associated with the feedback indicator is selected from the set of pre-calculated beam patterns available in memory. The scan management circuitry identifies the number of lines of scanning necessary to display the feedback indicator using the beam pattern. The laser beam is then manipulated to display the feedback indicator on a target surface.

For textual messages or textual feedback indicators, pre-calculated beam patterns do not exist, and are calculated by the control circuit. The number of lines of scanning necessary to display the textual information is then calculated by the scan management circuitry. The actual display of textual messages using the laser beam is very similar to the technique employed to display non-textual feedback indicators.

At a block 351, the system begins the display operation. If, at a control block 353, it is determined that the feedback indicators are to be displayed, control is passed to a block 355 where an image associated with the required feedback indicator is retrieved from memory for display. The feedback indicator may be textual or non-textual. At a block 357, the range of x-axis scans and y-axis scans are determined, and at a block 359, the scanning of the laser beam is initiated to display the feedback indicator. After the display of the feedback indicators at the block 359, the display operation is terminated at a block 361.

If, at the control block 353, it is determined that a feedback indicator is not necessary, control is passed to a control block 363 where it is determined if a message with a graphic image is to be displayed. If a graphic image is to be displayed, the image is scaled to the required size at a block 367 and control is passed to the block 357 for subsequent scanning range calculation and display.

If, at the block 363, it is determined that a message with a graphic image need not be displayed, then control is passed to a block 365 for the display of textual information. Block 365 determines if word wrapping is enabled. If word wrapping is not enabled, block 365 passes control to a block 369 for the scaling and assembling of textual information before display. If word wrapping is enabled, block 365 passes control to a block 371 for word wrapping and scaling of the textual information to be displayed. In either case, the scanning range for the textual information is determined at the block 357 and scanning and display is initiated at the block 359 before terminating the operation at the block 361.

Figs. 4a, 4c and 4e are exemplary scanned images received by three different scans, each corresponding to a different exemplary orientation of the hand-held scanning system 11 with respect to a coded image 25 being scanned, and Figs. 4b, 4d and 4f, respectively, are exemplary feedback indicators that are generated in response. When a coded image is scanned in, as indicated by Fig. 4a, the system 11 decodes the image and reads it successfully. The system also generates the feedback indicator shown in Fig. 4b to indicate the successful completion of the scanning activity.

When a coded image is scanned in with an orientation as shown by Fig. 4c, the feedback indicator of Fig. 4d is generated and displayed by the system in order to highlight the problem with the orientation of the system with respect to the coded image. In response to this feedback indicator, the operator is expected to correct the orientation as indicated.

When a coded image is scanned in with a skewed orientation as indicated by Fig. 4e, the system generates and displays the feedback indicator of Fig. 4f in order to highlight the problem with the orientation of the system with respect to the coded image.

With hand held systems, such as the one shown in Fig. 4, when the hand held system is activated to scan one-dimensional bar codes, the generation of one dimensional visual patterns for feedback indicators is interspersed with the activity of scanning for the coded images. While the activity of scanning for coded images is being carried out, the feedback indicators may not displayed. Thus, these two activities are mutually exclusive. In an alternate embodiment, it is possible to display feedback indicators while simultaneously scanning coded images.

Fig. 5 is a perspective diagram of an exemplary glove shaped hand-held portable data collection device, built in accordance with the present invention, that does not have room for a conventional LCD display at the top and relies on the generation of visual feedback indicators for communication with an operator. In this embodiment of the present invention, the hand-held data collection device 501 performs 1D laser scanning to read coded images, such as the coded image 505.

Even if there were room on the glove for a display unit, the addition of the display unit would add to the weight of the system and make it harder to use. Moreover, the operator wearing the glove would have difficulty aiming the glove at a target unit while simultaneously reading any displayed information on such a display unit. Thus, feedback indicators and other messages are instead displayed visually on the surface of a target unit 503.

When an operator tries to scan and read a coded image, such as the 1D bar code 505 located on the target unit 503, the glove shaped hand held data collection device 501 may not be properly aimed at the coded image. Again, the area scanned by the hand held device 501 may not completely cover the coded image 505, and feedback indicators are generated and displayed by the system 501 as necessary.

Figs. 6a-6c depict exemplary feedback indicators and messages for the hand held data collection system of the present invention, when the data capture system is only capable of one dimensional scanning. In particular, Fig. 6a shows a visual display pattern generated by scanning the laser beam and controlling the light generated. This horizontal line 601 indicates that the coded image is too close to the hand-held system and that the operator should move the hand held system further away from the coded image for effective scanning.

Fig. 6b depicts an exemplary situation where the hand held data collection device is too far from the coded image and the operator should get closer to the coded image for effective scanning. A feedback indicator 603 is displayed to facilitate the adjustment of the position of the hand held data collection system, such as the data collection system 501, with respect to the coded image, such as the coded image 505, by the operator. The operator can adjust the position of the hand held system by moving closer to the coded image.

Fig. 6c depicts an exemplary situation where the completion indicator is displayed after a successful scanning of a 1D coded image by the hand held data collection system. A feedback indicator 605 is displayed as a completion indicator.

Figs. 7a-7e are exemplary animated feedback indicators and messages for an hand held data collection system built in accordance with the present invention which is only capable of one dimensional scanning. Specifically, Fig. 7a shows an exemplary visual display pattern optically generated, in accordance with the present invention, by scanning a laser beam and controlling the light generated from the beam. A set of seven dashes 701, displayed in the order indicated (1 through 7) from left 1 to right 7, indicates that the hand held data collection system has been positioned to the left of the coded image and the operator should move the hand held data collection system to the right for effective scanning. This feedback indicator is visually displayed in the current operational field of view that extends from the position of the dash numbered 1 to the dash numbered 7 in the diagram, perhaps on top of the coded image, if the coded image happens to be in the field of view.

Fig. 7b shows another exemplary animated visual display pattern optically generated, in accordance with the present invention, by scanning a laser beam and controlling the light generated from the beam. A set of seven dashes 703 displayed in the order indicated from right to left indicates to an operator of a hand held data collection device, such as the one in Fig. 5, that the hand held system is positioned to the right of the coded image. The display of such a feedback indicator is a recommendation to the operator to adjust the position of the hand held device by moving it to the left of its current position.

Fig. 7c shows an exemplary animated visual display pattern optically generated, in accordance with the present invention, where the generated display is an animated feedback indicator 705. Such an animated feedback indicator 705 is generated by

scanning a laser beam and controlling the order in which the visual dots are generated from the beam. The dots that are visible are drawn in the order shown, from dot numbered 1 to dot numbered 4. When the dots are displayed in this order, an operator would perceive a moving dot, one that moves from the center to the ends, suggesting that the operator adjust the position of the hand held system by moving it further away from the coded image, for better coverage of a coded image and for better scanning. A similar animated feedback indicator is generated and displayed to recommend movement of the hand held system closer towards the coded image by the feedback indicator of Fig. 7d. To generate dots, the laser drive circuitry 209 of Fig. 2 manipulates the laser beam generated by the laser diode 263 in such a way so as to generate a fuzzy light beam that looks like a dot on the surface of a target unit, such as a box with a bar code label.

Fig. 7d shows another exemplary visual display feedback indicator generated in accordance with the present invention, where an animated feedback indicator is displayed to suggest that the operator move the hand held system closer towards the coded image for better scanning. The feedback indicator 709 is made up of a set of seven dots drawn in the order shown. The dots are drawn in the order of the numbers indicated in the diagram - from those numbered 1 to the one numbered 4. When the dots are displayed in this order onto a target surface, an animated feedback indicator is visually displayed that shows two dots from the extremes of the field of view moving towards the center. Such a display suggests to an operator that he should move the hand held system closer to the coded image being scanned.

Fig. 7e shows another exemplary visual display feedback indicator generated in accordance with the present invention, where an animated feedback indicator is

displayed, employing a line with two dashes 715, 713 that travel from its center to its ends. This feedback indicator can be employed to indicate the successful completion of the scanning activity.

Fig. 8 is a diagrammatic representation of another embodiment of a hand-held portable data collection system 801 that contains a plurality of LEDs for generating a scanning beam, built in accordance with the present invention, reading a one dimensional (1D) coded image. This system is a simpler embodiment and it does not contain a display device and its associated circuitry, such as the display 17 on top of the system 11 depicted in Fig. 1a.

The hand held data collection system 801 generates a beam 805 using the plurality of LEDs to scan a 1D coded image such as a bar code 803. The beam 805 is scanned across the 1D coded image 803 and the reflected signals are detected by a photo detector (not shown) within the hand held data collection system 801 and decoded by the hand-held data collection system 801.

In view of the above detailed description of the present invention and associated drawings, other modifications and variations will now become apparent to those skilled in the art. It should also be apparent that such other modifications and variations may be effected without departing from the spirit and scope of the present invention as set forth in the claims which follow.

Appendix A is a copy of Application No. 09/223,217 filed 12/30/98. Appendix A and said Application are each hereby incorporated herein by reference in its entirety, as showing further embodiments within the scope of the present disclosure.

What is claimed is:

1. A data collection device used with a target surface, the data collection device comprising:

a light source that emits a beam of light;

scanning circuitry, operable in a first and a second mode, that assists the light source in illuminating a target surface;

the scanning circuitry, when operating in the first mode, directs the light source to illuminate the target surface; and

the scanning circuitry, when operating in the second mode, directs the light source to selectively display a feedback indicator which is illuminated at the target surface.

2. The data collection device of claim 1, the light source selectively displays an animated visual two-dimensional feedback indicator.

3. The data collection device of claim 1, the light source displays information indicative of the state of the system.

4. The data collection device of claim 1, the data collection device is communicatively coupled to an external system, and the light source displays information received from the external system.

5. The data collection device of claim 4, further comprising:

wireless receiver circuitry to establish a radio frequency link with the external system;

the wireless receiver circuitry receives messages from the external system over the radio frequency link; and

the data collection device selectively displays at the target surface the messages received.

6. The data collection device of claim 1, further comprising:

a power consumption level value for the data collection device;

the scanning circuitry controls scanning activity through use of a plurality of lines employed in the illumination of the target source and the display of a feedback indicator; and

the scanning circuitry reduces the power consumption level value for the data collection device by limiting the scanning activity in both the first mode and the second mode to use only a minimum number of the plurality of lines.

7. The collection device of claim 6, the feedback indicator is a non-textual symbol, and the minimal number of lines of scanning are pre-calculated.

8. The data collection device of claim 1, further comprising:

a memory;

a plurality of feedback indicators;

a plurality of pre-calculated beam patterns saved in the memory, with at least one beam pattern being associated with a particular feedback indicator;

the scanning circuitry selects a beam pattern from the plurality of pre-calculated beam patterns to display the feedback indicator; and

the scanning circuitry causes the tracing of the light source along the selected beam pattern to display the feedback indicator.

9. The data collection device of claim 1, the scanning circuitry causes the light source to selectively display a feedback indicator indicating successful completion of a scanning activity of the target surface.

10. The data collection device of claim 1, the scanning circuitry causes the light source to display an animated visual one-dimensional feedback indicator on the target surface.

11. A data collection device used with a target surface, the data collection device comprising:

a light source that emits a beam of light;

control circuitry operable in a first mode and a second mode;

an image disposed on the target source;

the control circuitry assists the light source in capturing the image at the target surface in the first mode; and

the control circuitry assists the light source in displaying information at the target surface in the second mode.

12. The data collection device of claim 11, the information displayed at the target surface in the second mode is related to the image captured at the target surface in the first mode.

13. The data collection device of claim 11, the information displayed at the target surface in the second mode is a feedback indicator indicating the spatial relationship of the position of the data collection device with respect to the target surface.

14. A data collection device used with a target surface, the data collection device comprising:

a light source that emits a beam of light;

control circuitry operable in a first mode and a second mode;

an image disposed on the target source;

the control circuitry assists the light source in capturing the image at the target surface in the first mode; and

the control circuitry assists the light source in displaying at the target surface in the second mode information unrelated to the image captured at the target surface in the first mode.

ABSTRACT

During the operation of a hand-held data collection device, such as a bar code reader, visual feedback information is provided to the system operator indicating that the system is too far, too close, to the left of, or to the right of the target coded image, without distracting the operator or hampering the data collection activity. The visual feedback indicator can be textual or non-textual, and can be positional or non-positional, and may be both one-dimensional and two-dimensional. Information not related to the scanning activity, such as messages received from external systems or system-generated information are also visually displayed. The hand-held data collection device incorporates novel and efficient scanning features while displaying the feedback information or messages. The visual feedback indicators are displayed by tracing a laser beam in specific beam patterns. The pre-calculated beam patterns for standard feedback indicators are stored in memory. For efficiency in scanning and to save on power consumption, only the required number of lines, pre-calculated for standard feedback indicators, are scanned with the laser beam. Several different kinds of information are visually displayed. Both graphical and textual messages received over a wireless link during a scanning activity are displayed optically. System generated messages containing status information are also displayed. In another embodiment, feedback indicators are visually displayed in conjunction with displays on a conventional display device such as an LCD screen.

APPENDIX A

Copy of Application No. 09/223,217 Filed 12/30/98
Consisting of
Specification Pages 1-13 and
Drawing FIGS. 1, 2, 3A, 3B, 4, 5 and 6

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APPENDIX A

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICATION FOR PATENT

TITLE:

HAND-HELD COMPUTER WITH PROJECTION DISPLAY OUTPUT

SPECIFICATION

RELATED APPLICATION

This application claims priority under 35 U.S.C. § 119(e) to U.S. provisional application Serial No. 60/070,305, filed December 31, 1997.

FIELD OF THE INVENTION

The present invention relates generally to portable computers and, more particularly, to hand-held data collection terminals employing a spatial light modulator to provide a projection output display.

BACKGROUND OF THE INVENTION

Portable data terminals or computers are commonly used in a variety of mobile applications such as warehousing, distribution, delivery, and the like. It is advantageous to employ portable computer terminals as the primary data collection points of business information, such as sales, distribution, control and inventory of products delivered, and delivery or tracking of products, packages, etc. Portable or hand-held data terminals have proven useful in increasing the efficiency of such applications by automating the entry and

electronic storage of order, sales, delivery, receipt, pricing, inventory control, and other information.

Data collection terminals are typically self-contained, battery powered, microprocessor controlled devices. The data collected and stored by the computer is often connected to a host computer or computer network for uploading of the collected data to a central computer and downloading of the assignments for the next day or next shift. Data collection units that are intermittently linked for uploading data collected during a work shift, e.g., by the user physically docking the unit in a docking station for data transfer with a network or host computer, are batch processing units. Docking stations often provide battery charging as well as a data communication link. Docking stations may be physically connected to a network or host computer, or may be connected to a wireless port for use in a truck, van, forklift, or the like. Data terminals that are equipped with a radio transceiver may upload data and download assignments continuously or periodically throughout a workday or work shift. Data collection terminals equipped with a radio transceiver provide information regarding transactions, inventory, marketing activity, route delivery, or other pertinent business information on a frequently updated or real time basis. A typical example is a data terminal equipped with an RF transceiver for use in an RF network installation such as in a warehouse setting.

Hand-held portable data collection systems may typically utilize an optical symbology reader having a bar code scanner or CCD reader to collect optically encoded information. A portable data collection terminal, for example, may include a laser scanner system which sweeps a laser beam lengthwise across a bar code in which information is encoded. The laser scanner system detects the varying intensity of the reflected light as the laser beam reflects off of the regions of varying light intensity of the bar code. The pattern of light intensity describes a numerical code from which the encoded information may be electronically extracted.

When a computer terminal is designed primarily for use in a portable or mobile setting, it is desirable to make the data terminal small and lightweight. Although computer terminals exist which are small enough to be hand-held in operation, i.e., which can be carried or held in one hand while being operated with the other, the degree to which the size

of a data terminal may be reduced will depend on the functionality desired from the unit. As a data terminal is designed smaller, the resulting space limitations may result in ergonomic disadvantages. For example, a hand-held data terminal will typically comprise a housing upon which a keypad or keyboard area and a display area are located. By reducing the size of the keypad and/or display areas, a data terminal may be made smaller. However, when the size of the keyboard is made smaller, the number of keys may be limited. In such cases, a limited set of input keys can be compensated for by large display with a graphical user interface or other menu or window driven interface which may be, for example, navigated with a manipulable cursor, touch screen, or the like. Thus, a data terminal with four input keys will be more limited for keypad input than a data terminal with a full numerical or alphanumeric keypad. Likewise, a data terminal with an LCD display sized to display two lines of text may be made smaller than a data terminal with a large display, such as a 640x480 or 320x480 VGA display, however, the visual interface will be less robust.

In addition to size and weight, a hand-held data terminal should additionally be rugged enough for use in a mobile environment. For example, a portable data terminal should be protected against external contaminants such as rain and dust, and should be protected against excessive shock due to dropping or rough handling.

The housing of a data terminal may be made shock resistant by using shock resistant plastics or other materials and by co-molding a shock absorbing material to the surface of the housing in order to distribute the impact forces to which the data terminal may be exposed as a result of a fall. However, typical displays, such as LCD displays employ glass plates which may break as a result of excessive force. Also, the individual pixels or the fine wires attaching the pixel grid to the display driver circuit boards are also subject to damage from dropping, pressure applied to the display, and the like.

It would, therefore, be desirable to provide a portable data terminal that provides a robust visual user interface, but that requires neither a built in display screen nor any connection to an external monitor, and which may, therefore, be made very small and lightweight while still providing an ergonomically favorable human interface.

SUMMARY OF THE INVENTION

It is, therefore, an object of the present invention to provide a portable, or more preferably, hand-held data terminal which eliminates the need for a built in viewable display in order to provide a robust visual interface.

Another object of the present invention is to provide a hand-held data terminal with a projection display of sufficient size to allow a robust visual or graphical user interface wherein an operator may be interactively prompted through the data collection process via visual display prompts.

Yet another object of the present invention is to provide a data terminal having an optical indicia reader wherein a projected display further comprises target information or cues to assist the operator in aiming or aligning the optical reader during the optical scanning process.

Still another object of the present invention is to provide a package labeling system which is cooperable with the hand-held data terminal according to the present invention.

Finally, another object of the present invention is to provide a hand-held shell module with a built in display capable of receiving the data terminal according to the present invention and providing a display therefore.

The objects and advantages of the present invention are provided by a hand-held data terminal wherein a conventional flat screen display is replaced by a projection display. The projection display according to the present invention comprises a light source, a spatial light modulator for modulating the light emitted by the light source in response to a computer video signal to produce an optical image that corresponds to visual output of the data terminal, and a lens to project the resulting image. In this manner, the computer output that would normally be visualized using a display such as an LCD display may be viewed as a projected image on a nearby surface.

Various other features and advantages of the invention will become apparent when the detailed description below is read in reference to the appended drawings. The appended drawings, which are incorporated in and constitute a part of the specification, illustrate an embodiment of the invention and together with the general description, serve to explain the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The detailed description of the invention may be best understood when read in reference to the accompanying drawings wherein:

FIG. 1 illustrates a preferred application of the data terminal according to the present invention;

FIG. 2 depicts a preferred embodiment according to the present invention;

FIGS. 3A and 3B depict another aspect of the present invention wherein the projected visual display of the present invention can provide a visual interface which is capable of guiding the optical scanning process by providing targeting information;

FIG. 4 depicts packaging useable together with the data terminal according to the present invention;

FIG. 5 depicts an alternative embodiment according to the present invention employing a trigger actuated scanning handle; and

FIG. 6 depicts a shell module having a flat screen display useable together with the hand-held data terminal according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to FIGS. 1 and 2, there is shown a portable data collection terminal or data terminal which is designated generally by the numeral **10**. The data collection terminal **10** is a preferably a handheld unit, which is understood in the art as being powered by a self-contained power source. Data terminal **10** is sized to be useable in the palm of a user's hand, and may optionally be sized even smaller, for example, to fit into a pocket. Such a portable data terminal **10** may operate in what is referred to as a batch mode in which data are collected by, and stored within, the data terminal **10** to be transferred to an alternate data processing unit or host computer (not shown) in a comprehensive "batch" type data transfer operation. Alternatively, the data terminal **10** may be in communication with such a host computer in an interactive or on-line mode via a data communications link, such as a radio frequency transceiver arrangement.

The data terminal **10** preferably has an elongate, generally rectangularly shaped housing **12**. The elongate housing **12**, preferably of a high-impact-strength plastic material,

encases the data terminal **10**. Various types of moldable high-impact-strength plastic materials are known and are generally available. Housing **12** preferably further comprises an elastic or resilient plastic or rubber material co-molded to portions of the rigid, high-impact strength plastic material. The data terminal **10**, as depicted in FIGS. 1 and 2, comprises a top shell **14** of housing **12** and a base shell **16** of housing **12**. A keyboard or keypad **18** is located on the top shell **14**. Since the data terminal **10** according to the present invention lacks a built in display, but rather is intended to project the display output to a nearby surface, the keypad or keyboard **18** may utilize all or nearly all of the upper surface area of top shell **14**.

The data terminal according to the present invention may further comprise ports for attaching an external monitor or other peripheral devices, such as printers, modems or fax modems, graphic scanners, text scanners, code readers, magnetic card readers, voice command interfaces, external storage devices, contacts for battery charging, RF transceivers, antennae, and the like. Also, the data terminal according to the present invention may be used in conjunction with a docking apparatus, which may be stationary or may be located in a vehicle, which allows connection to a host computer or computer network and which may also provide connection to peripheral devices, such as printers, modems or fax modems, graphic scanners, text scanners, code readers, magnetic card readers, voice command interfaces, external storage devices, contacts for battery charging, RF transceivers, antennae, and the like.

In an alternative embodiment (not shown), a portion of the top shell **14** may be reserved for rudimentary output of a visual nature, such as LED indicators (not shown) and/or a small secondary display (not shown) (for example, a one- or two-line monochromatic LCD display would be sufficient), for providing information such as whether the unit is powered on, battery charge status, projection display brightness indication, the date and time, scan success or failure indication, data transfer in progress or data transfer complete indication, and the like.

The display output of data terminal 10 is provided by a spatial light modulator or silicon light engine **24** which produces an image which may projected onto a nearby flat surface. In the embodiment depicted in FIG. 2, the display image is projected through a lens

20 mounted on base shell 16. Light emitted by light source 22 is modulated by spatial light modulator 24 in response to video output signals of the data terminal 10. A mirror 26 may also be provided to direct the image.

In an embodiment not shown, the lens 20 may optionally be moveable by a user to provide focusing, or may optionally provide an infrared sensing or other optical, including laser, sensing transmitter and receiver in order to determine the distance between the data terminal 10 and the surface upon which the display is imaged so that auto-focusing of lens 20 may be provided.

FIG. 1 shows an advantageous application of the data terminal 10 according to the present invention wherein the inventory, goods, packages, or the like, which are the subject matter of the data collection process, contains a suitable surface area upon which the projection display may be imaged. FIG. 1 depicts a data terminal 10 projecting a display image 40 onto a carton 30. A plurality of cartons 30 are depicted, as might be typical in a warehouse, distribution center, or other inventory control center. Inventory control may be performed by an optical indicia reader or scanner (not shown) which may be a separate unit, e.g., connected through an I/O port, or, most advantageously, may be built into or otherwise disposed on data terminal 10.

The use of a projection display allows a data terminal 10 to be quite small, while still providing a robust visual interface. An operator may be provided with graphical, menu, or text prompts appearing on the image 40, to which responses can be input through the keypad 18, which can thus direct an operator in little time through complex inventory or order taking problems.

The power of the light source 22 is advantageously variable so that the brightness of the projected display can be adjusted according to the ambient lighting conditions or the color of the cartons upon which the display will be imaged. It is further possible and desirable to provide a photosensor (not shown) disposed on the housing 12 to automatically adjust the brightness to the ambient lighting conditions.

In another aspect of the present invention, the data terminal 10 may be advantageously employed in conjunction with cartons with prespecified characteristics. For example, a manufacturer or shipper of goods may employ the data terminal according to the

present invention with cartons which have an area of predetermined size and/or location upon which no printed indicia, stickers, or the like will appear, and may be ordered as such from a carton supplier. Alternatively, cartons which do not have a suitable display area for imaging display **40** (e.g., as a result of printed indicia or the like, or wherein the carton surface itself is darkly colored) may be made suitable by placing a sticker, preferably white or light in color on the side of carton **30** where display imaging is desirable.

FIGS. 3A and 3B depict another aspect of the present invention wherein the projected visual display of the present invention can provide a visual interface which is capable of guiding the operator during an optical scanning process by providing targeting information in a manner not possible with a conventional display screen. In FIG. 3A, the data terminal **10** may be programmed to prompt the user during the data collection process wherein one of the prompts may serve as an aid in aligning the data terminal **10** for optical reading of bar code **32** or other optical indicia. In the exemplary embodiment, the operator is prompted in FIG. 3A to align display output indicia **42** with the optically readable indicia to be scanned, at which time the operator can redirect the display image **40** to the orientation as depicted in FIG. 3B, at which time the optical scanning hardware (not shown) will then likewise be in proper alignment for scanning, and the optical reading process may be completed, for example, via an auto-detection feature of the data terminal processing logic, or via manual activation by the operator. The operator may then redirect the display image **40** to a surface free of indicia, such as area **36**, and thus continue as necessary for the particular data collection assignment.

FIG. 4 shows an exemplary carton **30'** usable together with the data collection terminal according to the present invention wherein carton **30'** has area **34** thereon for projection of the data terminal display output. Area **34** may be a rectangular area of a suitable light colored or reflective surface which may be printed thereon or attached thereto by adhesive. Where the cartons **30'** themselves are comprised of a suitably light colored material, area **34** may simply comprise printed frame for alignment of the display image. Advantageously, the relative placement of display area **34** and bar code area **32** is such that any optical scanner attached to or disposed on or within the data terminal will be aligned with the bar code area **32** when the display image is positioned within area **34**.

Referring now to FIG. 5, a hand-held portable data collection terminal **100** according to the present invention is illustrated. The data collection terminal **100** preferably generally comprises an upper section **140** and a lower section **160**. A keyboard or keypad **180** is disposed on the upper section **140** for manual keying of data into the terminal **100**. The terminal **100** includes an optical system comprising a light source (not shown) and a spatial light modulator (not shown) which may be output through lens **200**. An exemplary configuration is depicted wherein lens **200** is disposed on top end **162** of lower section **160** for imaging computer display output, and wherein the terminal **100** further includes an optical reader **280** integrated with the terminal disposed on top end **142** of upper section **140** of the terminal **100**. The optical reader **280** may utilize a laser bar code scanner or CCD array for optical character reading.

The terminal **100**, as depicted, is designed for hand-held operation and therefore may be operated in the palm of a user's hand by generally gripping the terminal **100** on the lower section **160** opposite the keypad **180**. The terminal **100** is shown with a preferably removably attachable scanning handle **164**, which is attachable to the lower section **160** of the data terminal **100** to facilitate pistol type scanning operation. The scanning handle includes a trigger actuator **166** for actuating the optical character reader to control scanning or communications, for example.

FIG. 6 depicts a hand-held display shell module **300** having a display **310** which may be an LCD screen, gas plasma display, or other flat panel display, disposed on upper end **312** thereof. Display **310** is preferably an LCD screen. Display screen **310** may further comprise a substantially transparent touch screen overlay by which user input may be entered via a stylus or finger. Display **310** may optionally further comprise a backlight (not shown).

Display shell module **312** further comprises a cavity **314** disposed beneath display screen **310** in the top surface of display shell module **300** for receiving a data terminal **100** according to the present invention. Cavity **314** preferably has mounted on the surface thereof ports and connectors, including, but not limited to IR port **316**, electrical connector **318** which may additionally serve as a data port, video connector **320**, and data port **322**, which are aligned with corresponding mating ports (not shown) on the housing of data terminal **100**.

Display shell module **300** may further comprise additional peripheral devices, including, but not limited to, a modem or fax/modem device (not shown), an RF transceiver (not shown), or, where data terminal **100** has a built in RF transceiver, a high gain antenna (not shown) which may be electronically coupled to an RF transceiver of the data terminal **100**. Display shell module may contain one or mode additional batteries or battery packs, or may obtain power from the power source of the data terminal **100**. Alternatively, data terminal **100** may be powered by and/or the batteries of data terminal **100** may be recharged by the power supply of shell module **300** or an external power supply attached thereto. Module **300** may also contain additional memory such as volatile memory (RAM) or non volatile memory for mass storage, such as a hard disk drive, solid state based memory, such as EEPROM, flash memory, and the like, and so on.

Thus, it will be seen that the described invention accomplishes at least all of the objects and aims recited herein. The description above should not be construed as limiting the scope of the invention, but as merely providing illustrations to some of the presently preferred embodiments of this invention. In view of the above detailed description of a preferred embodiment and modifications thereof, various other modifications will now become apparent to those skilled in the art. The claims below encompass the disclosed embodiments and all reasonable modifications and variations without departing from the spirit and scope of the invention. Accordingly, the scope of the invention should be determined solely by the appended claims and their legal equivalents.

CLAIMS

What is claimed is:

1. A computerized data terminal of a type sized to be used while being held in one hand, said data terminal being further of a type having a housing and having input keys disposed on the surface of said housing, said data terminal having a projection display output, said projection display output comprising a source of light, a spatial light modulator for modulating light from said light source in response to video signals, and a lens for imaging said computer video output onto a nearby surface.

2. The computerized data terminal according to claim 2 comprising one or more LED indicators disposed on said housing.

3. The computerized data terminal according to claim 2 wherein no computer display is disposed on said housing.

4. The computerized data terminal according to claim 1 further comprising an LCD display screen disposed on said housing wherein said LCD display screen is sized to display one or two lines of text.

5. The computerized data terminal according to claim 1 further comprising an optical indicia reader.

6. The computerized data terminal according to claim 5 wherein said optical indicia reader is a bar code reader.

7. The computerized data terminal according to claim 5 wherein said optical indicia reader is a two-dimensional optical symbology reader.

8. The computerized data terminal according to claim 5 further comprising one or more LED indicators disposed on said housing.

9. The computerized data terminal according to claim 5 further comprising a handle and a trigger attached to said handle for actuating said optical indicia reader.

10. The computerized data terminal according to claim 9 wherein said handle and trigger are removably attachable to said data terminal housing.

11. The computerized data terminal according to claim 5 further comprising processing logic capable of providing targeting cues for aiming said optical indicia reader.

12. A data collection system, said data collection being of a type sized to be used while being held in one hand, comprising:

a computerized data terminal, said data terminal being of a type having a housing and having input keys disposed on the surface of said housing, said data terminal having a projection display output, said projection display output comprising a source of light, a spatial light modulator for modulating light from said light source in response to video signals, and a lens for imaging said computer video output onto a nearby surface;

a display shell module, said display shell module comprising a display screen and further comprising a recessed area such that said data terminal may be substantially contained within said shell module during hand-held operation; and

a video connection port for outputting a computer video signal from said data terminal to said display shell module.

13. A packaging carton having optically readable indicia on a surface thereof, said optically readable indicia encoding information suitable for data collection by a data terminal having a projection display output and an optical scanner, said packaging carton further comprising a display area on said surface for imaging a projected computer display, wherein the boundaries of said display area are visibly detectable, said display area being substantially free of markings, wherein the relative placement of said display area and said optically readable indicia is such that positioning said projection display output within said display area also serves to align said optical scanner with the optically readable indicia for optically scanning said optically readable indicia.

14. In a hand-held data terminal, a projection display output comprising a source of light, a spatial light modulator for modulating light from said light source in response to video signals, and a lens for imaging said computer video output onto a nearby surface.

ABSTRACT OF THE DISCLOSURE

A hand-held data terminal employs a projection display, thus eliminating the need for a flat screen display conventionally employed in hand-held data terminals. The projection display according to the present invention comprises a light source, a spatial light modulator for varying the light emitted by the light source to produce an optical image that corresponds to visual output of the data terminal, and a lens to project the resulting image. In this manner, the computer output that would normally be visualized using a display such as an LCD display may be viewed as a projected image on a nearby surface, thus allowing the data terminal to be made smaller while providing a robust visual user interface.

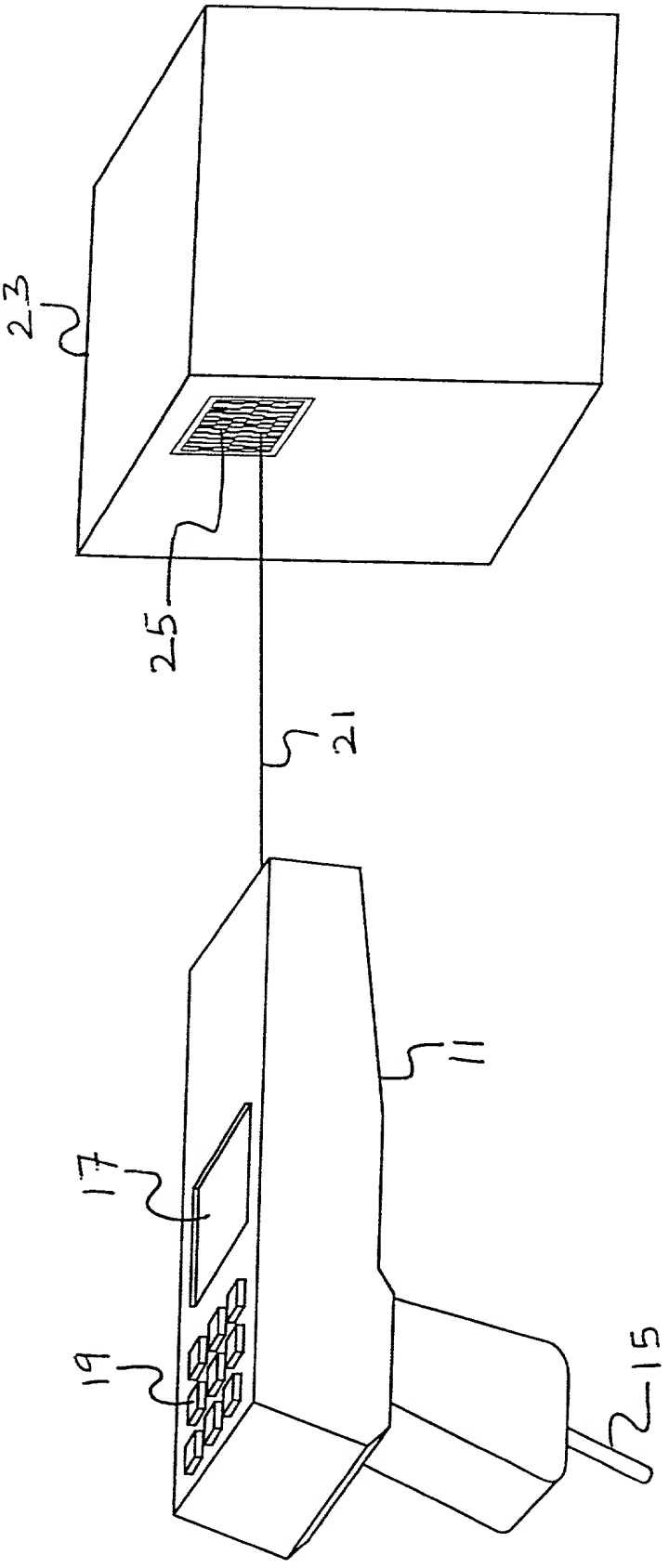

FIG. 1a

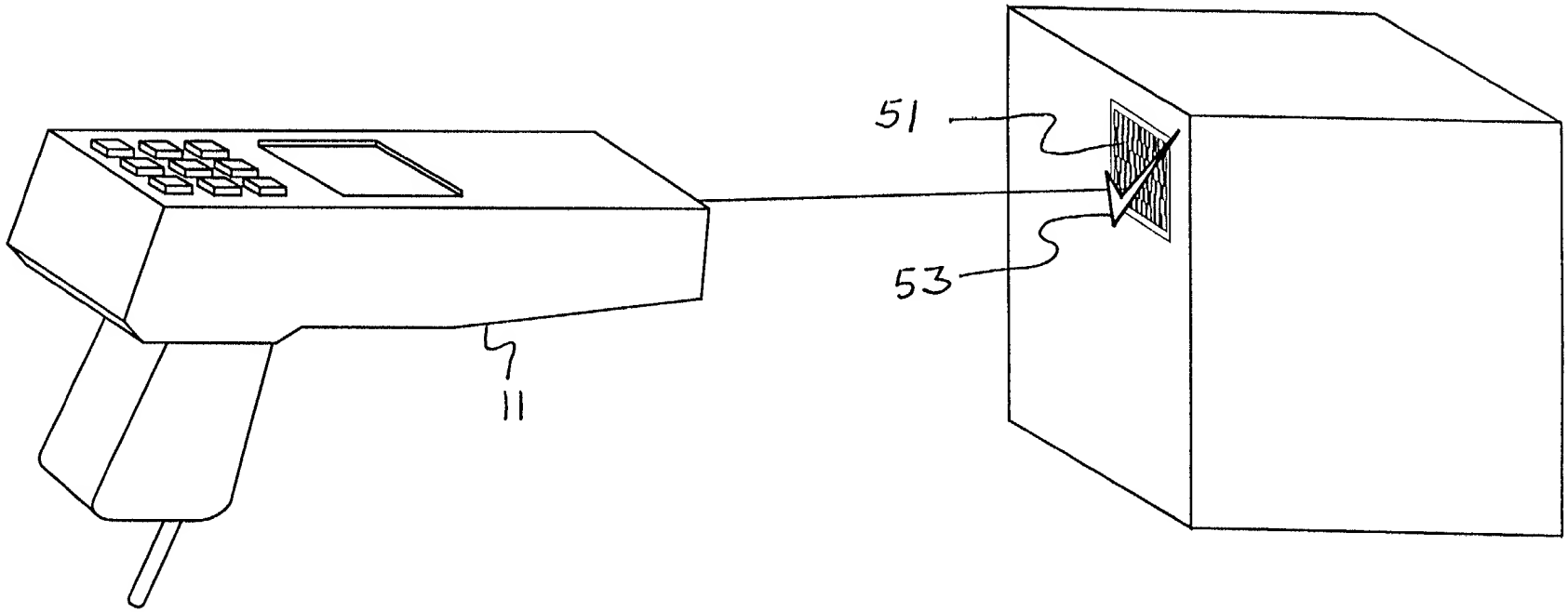

FIG. 1b

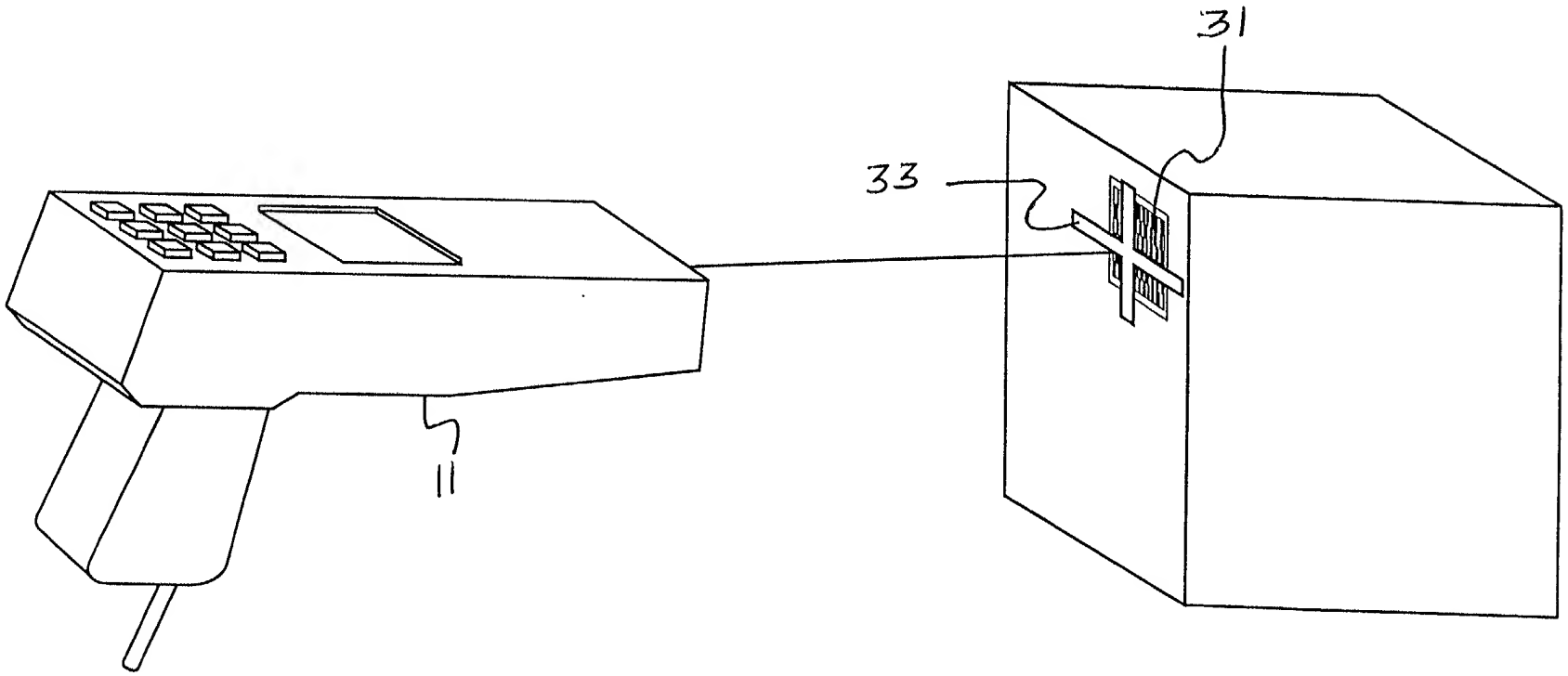

FIG. 1c

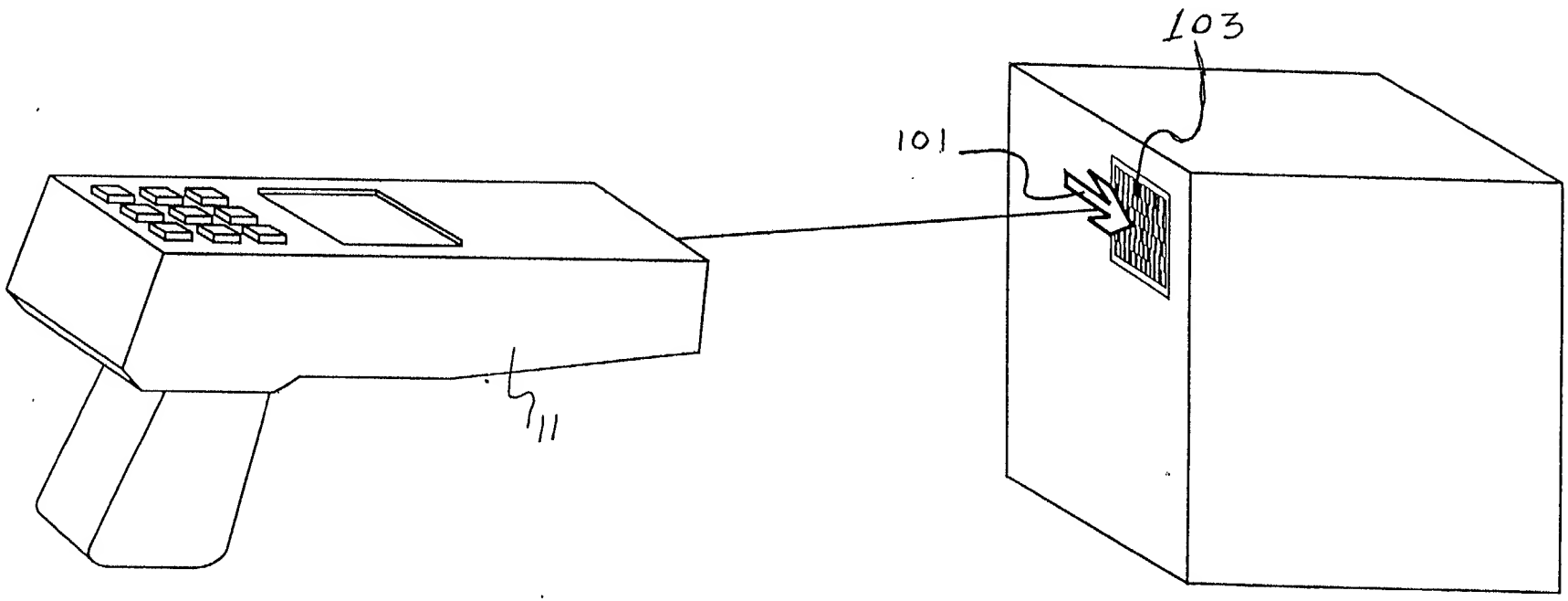

FIG. 1d

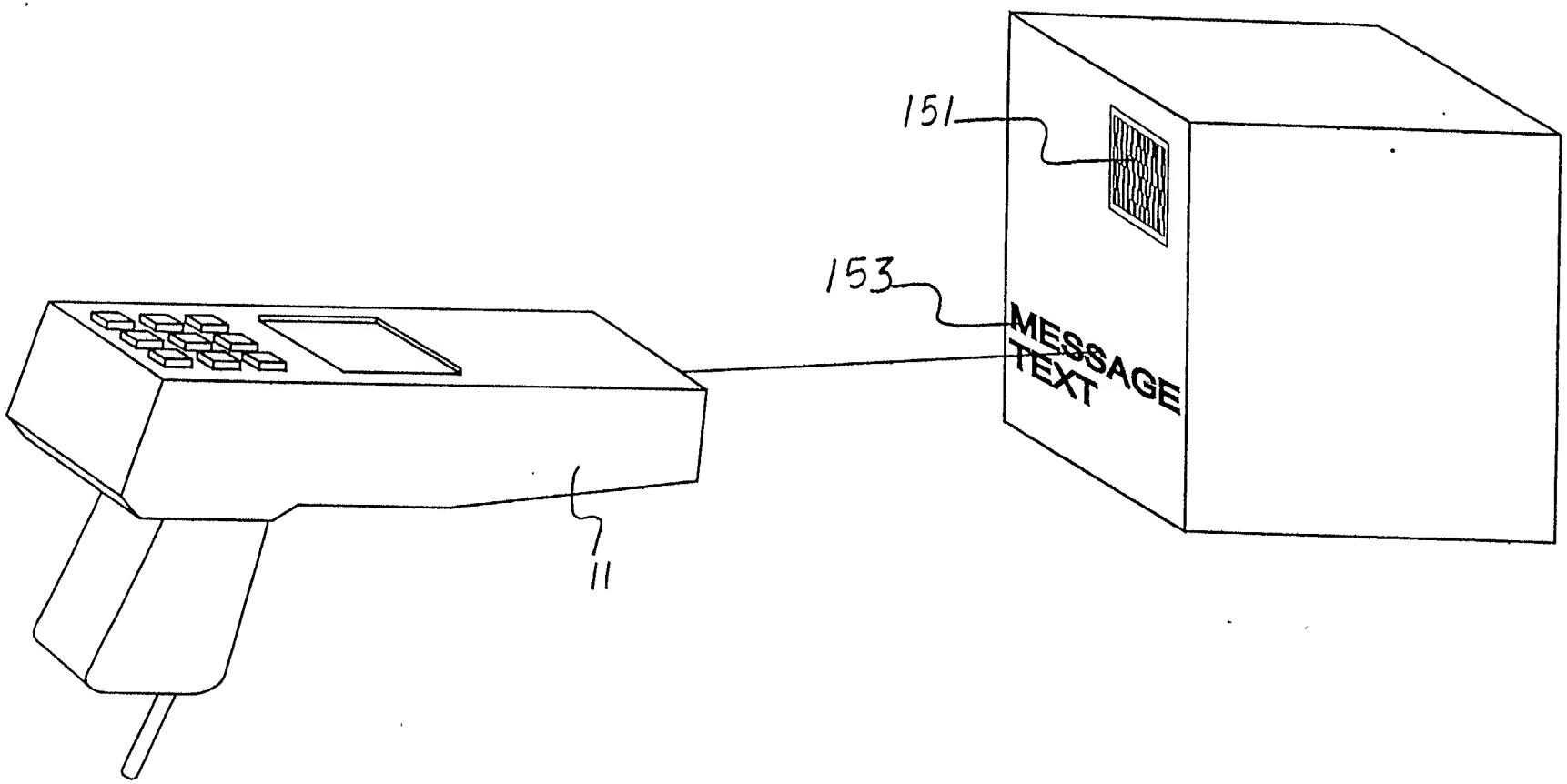

FIG. 1e

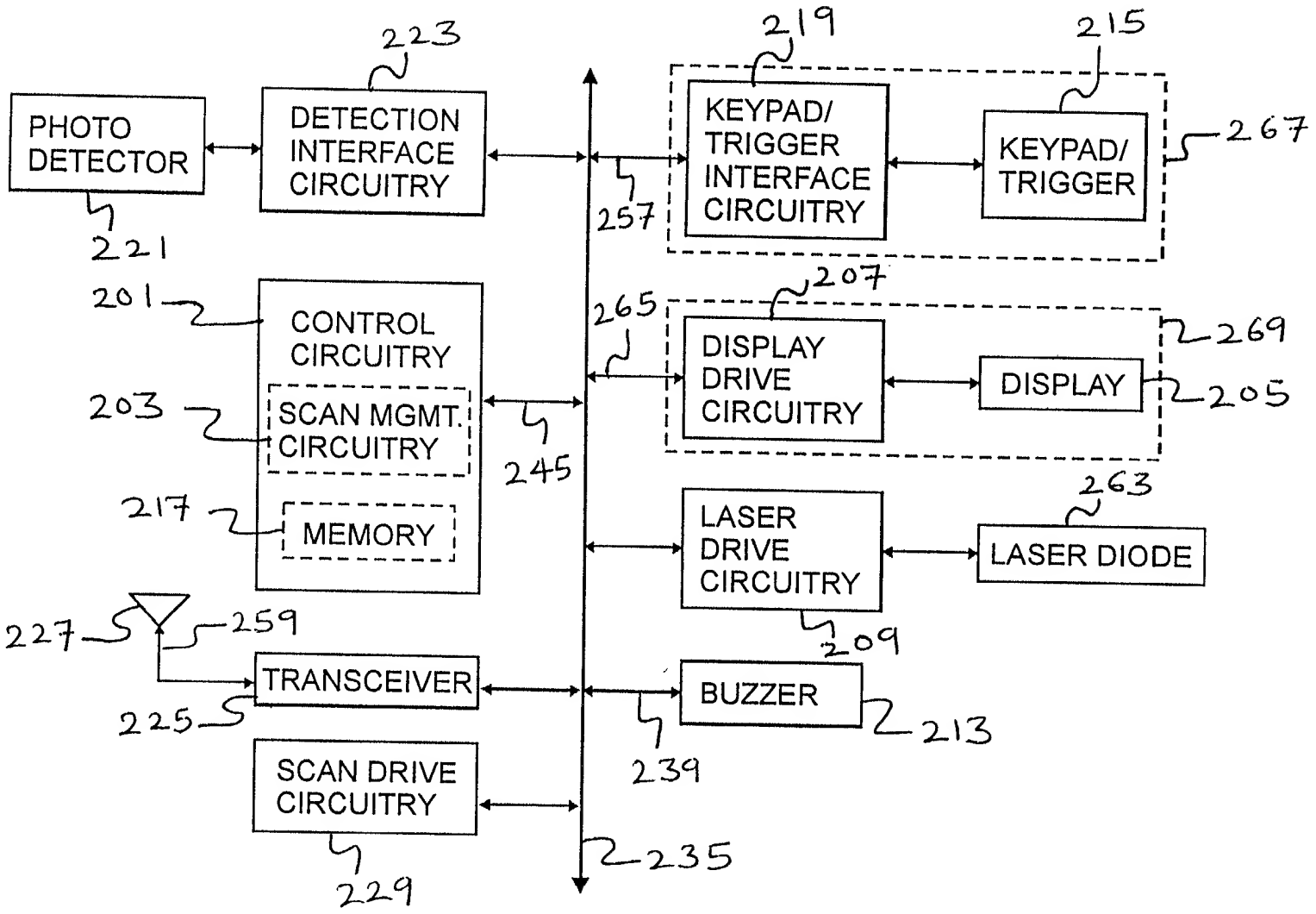
PHOTO DETECTOR
221
DETECTION INTERFACE CIRCUITRY
223
257
KEYPAD/ TRIGGER INTERFACE CIRCUITRY
219
KEYPAD/ TRIGGER
215
267
201
CONTROL CIRCUITRY
203
SCAN MGMT. CIRCUITRY
217
MEMORY
245
265
207
DISPLAY DRIVE CIRCUITRY
DISPLAY
269
205
LASER DRIVE CIRCUITRY
263
LASER DIODE
209
227
259
TRANSCEIVER
225
BUZZER
213
239
SCAN DRIVE CIRCUITRY
229
235

FIG. 2

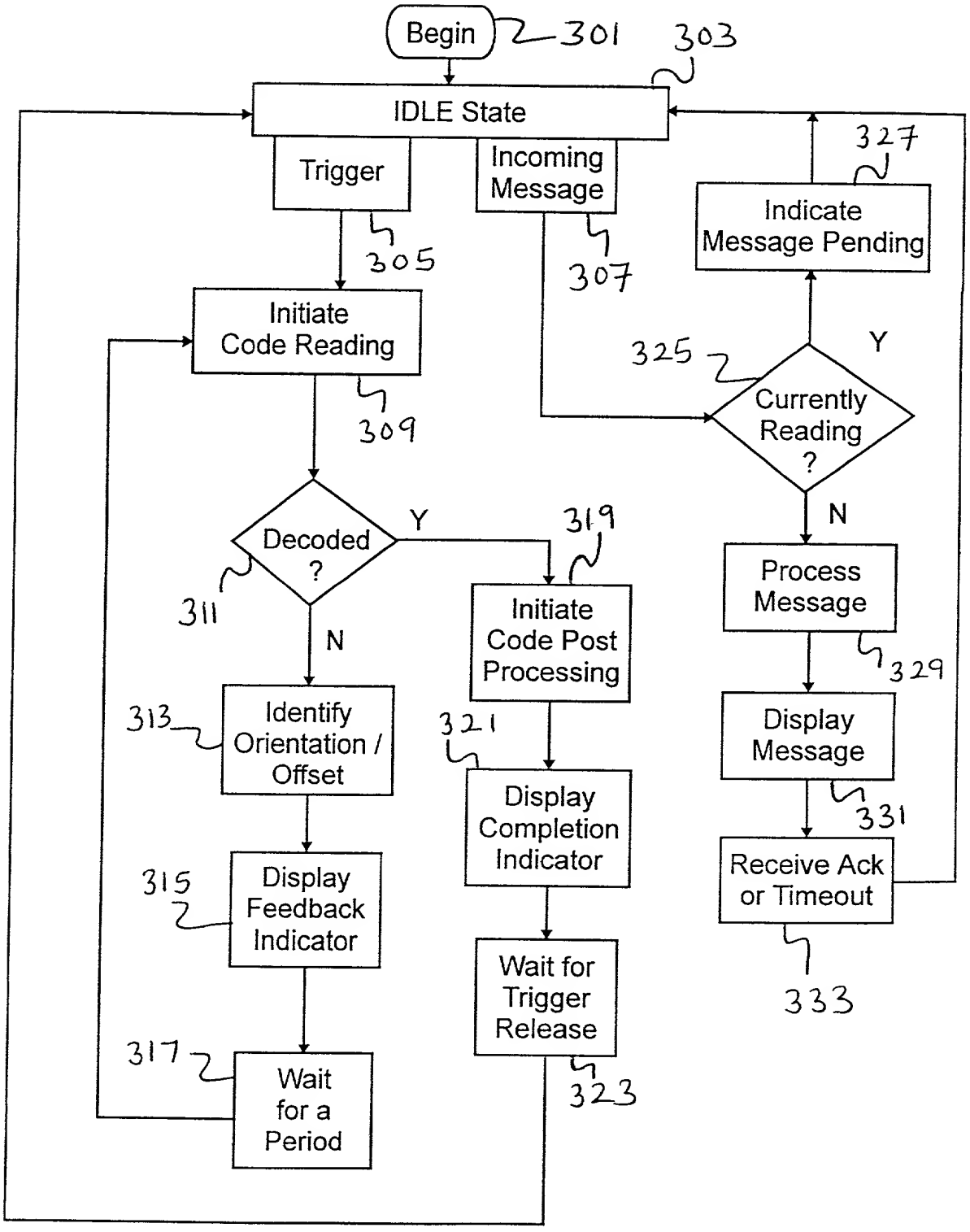
Begin
301
303
IDLE State
Trigger
Incoming Message
305
307
327
Indicate Message Pending
Initiate Code Reading
309
325
Y
Currently Reading ?
N
Decoded ?
Y
319
311
N
Initiate Code Post Processing
Process Message
329
313
Identify Orientation / Offset
321
Display Message
331
Display Completion Indicator
315
Display Feedback Indicator
Receive Ack or Timeout
333
Wait for Trigger Release
317
323
Wait for a Period

FIG. 3a

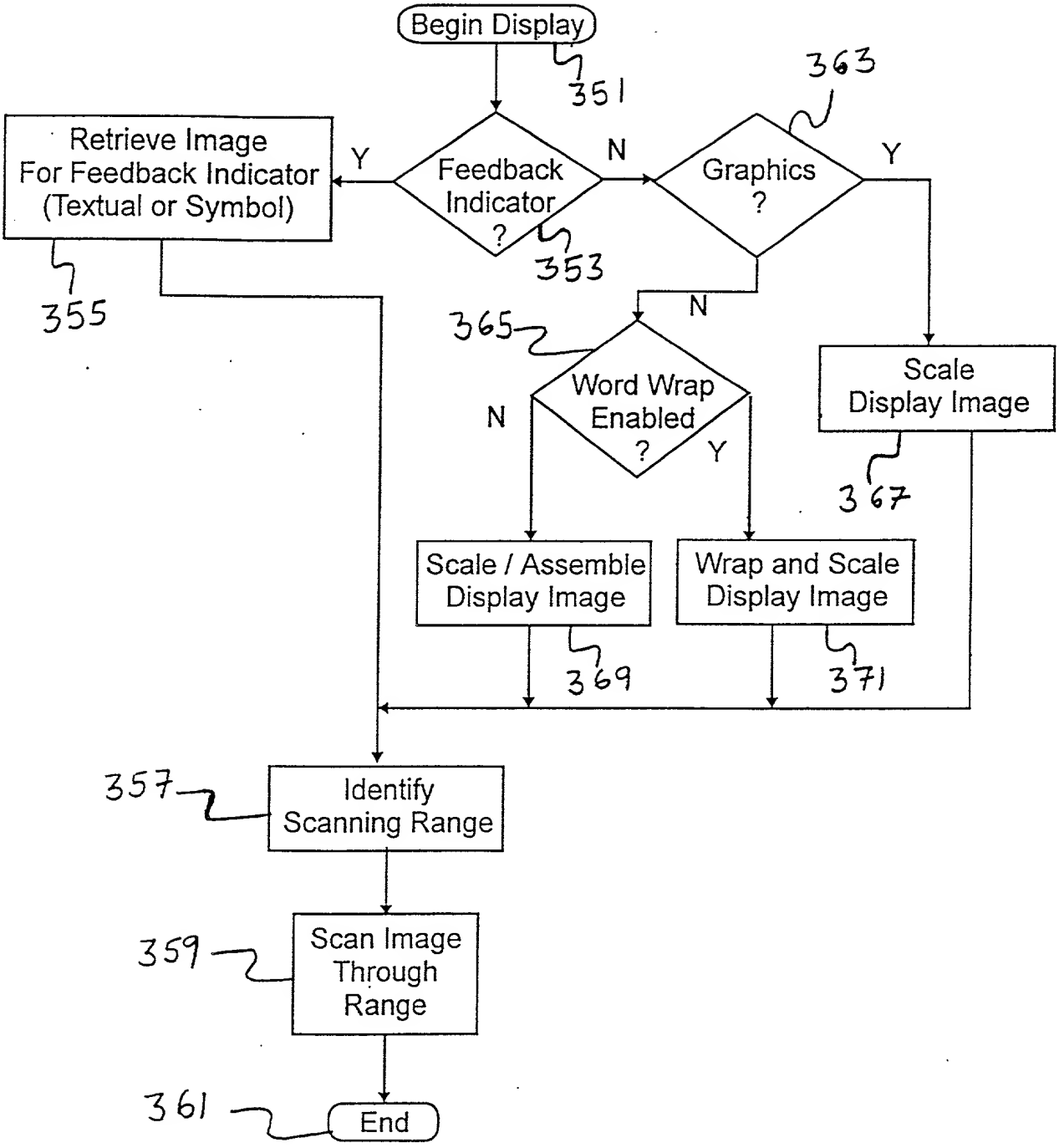
Begin Display
351
363
Retrieve Image For Feedback Indicator (Textual or Symbol)
Y
Feedback Indicator ?
N
Graphics ?
Y
353
355
N
365
Word Wrap Enabled ?
N
Y
Scale Display Image
367
Scale / Assemble Display Image
Wrap and Scale Display Image
369
371
357
Identify Scanning Range
359
Scan Image Through Range
361
End

Fig. 3b

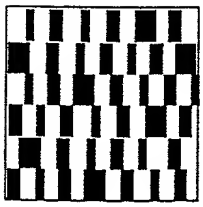

Fig. 4a

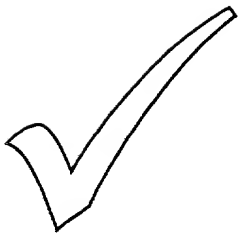

Fig 4b.

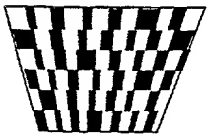

Fig. 4c

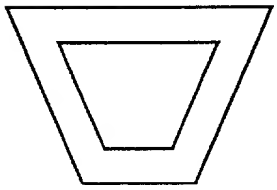

Fig. 4d

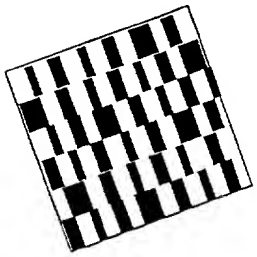

Fig. 4e

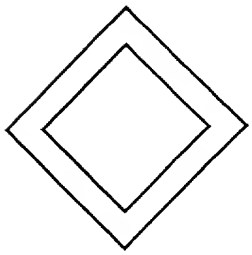

Fig. 4f

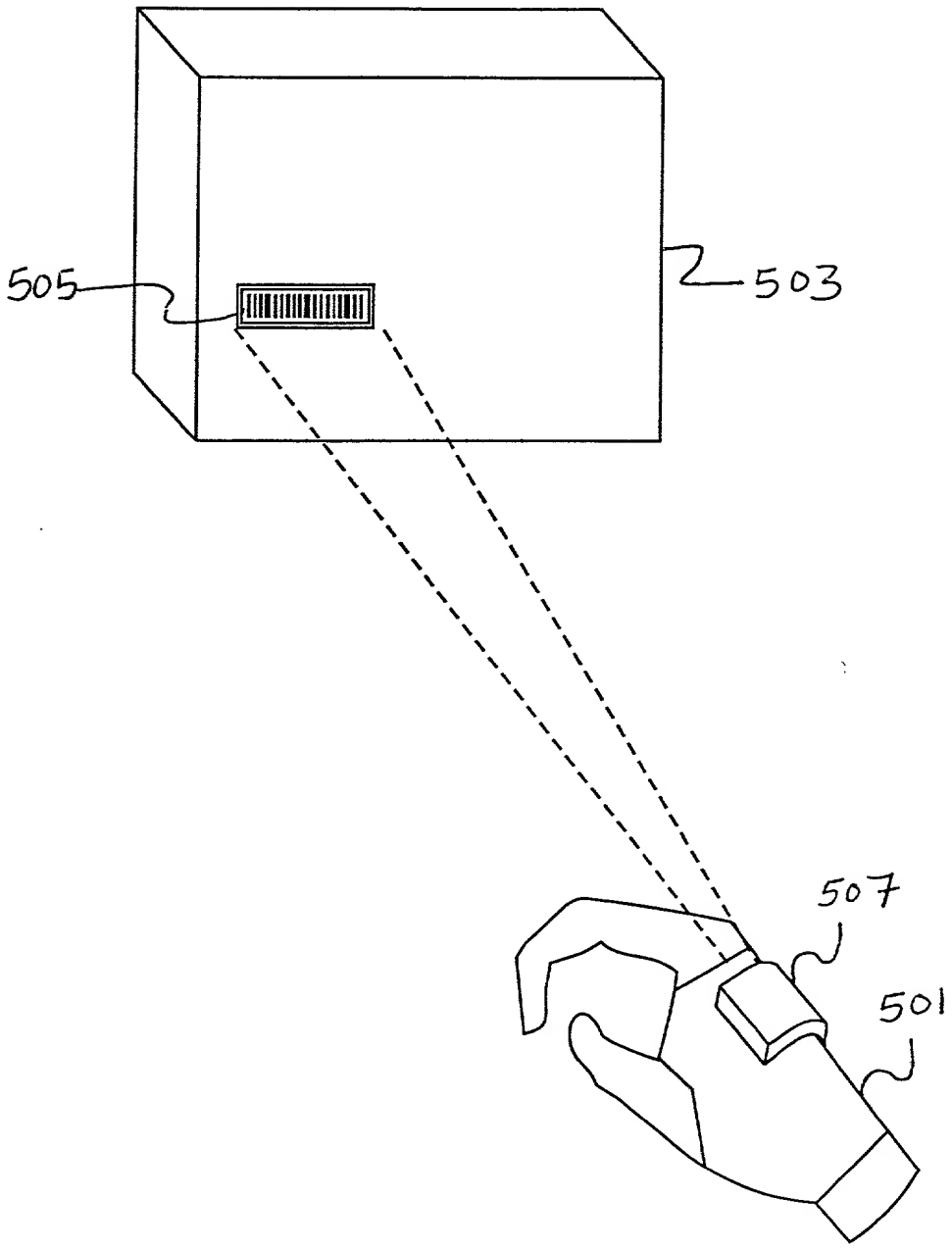

FIG. 5

FIG. 6a

FIG. 6b

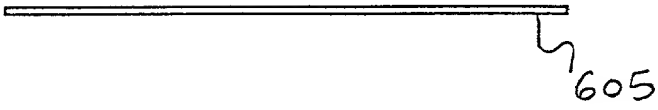

FIG. 6c

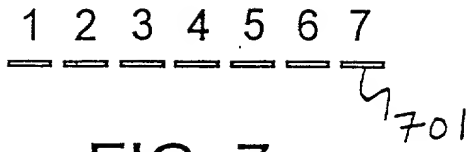

FIG. 7a

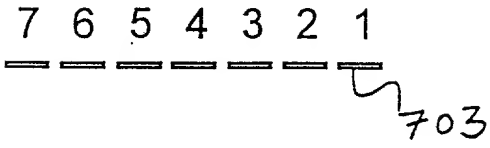

FIG. 7b

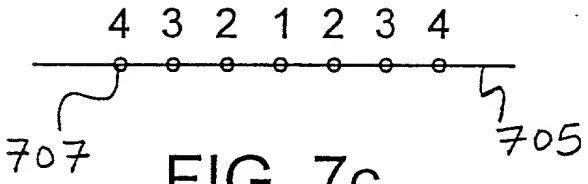

FIG. 7c

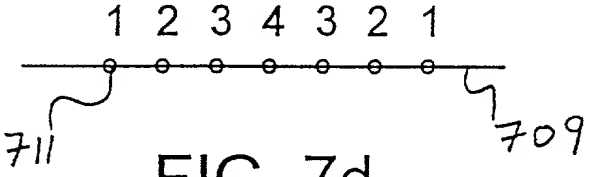

FIG. 7d

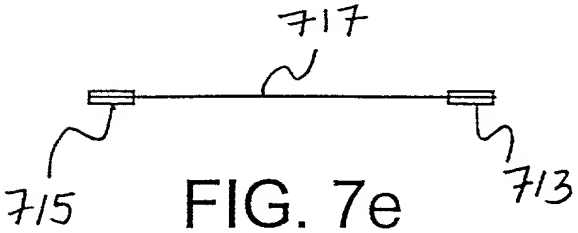

FIG. 7e

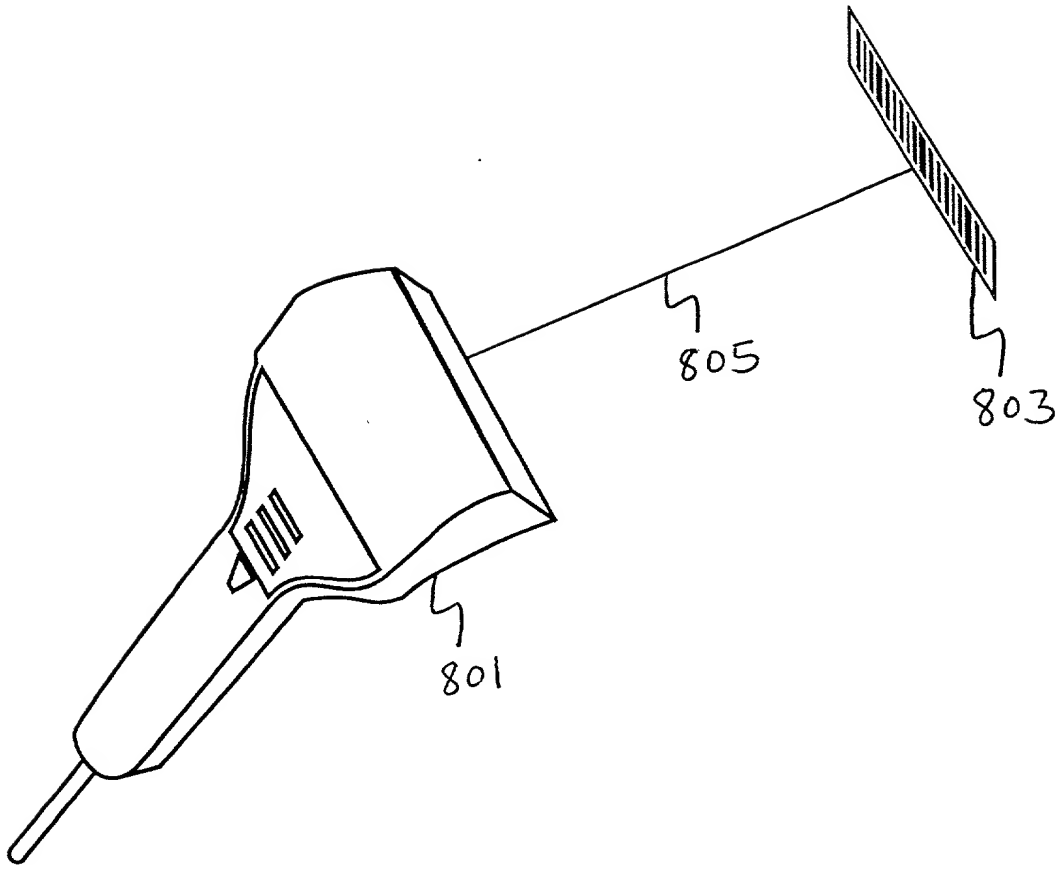

Fig. 8

APPENDIX A

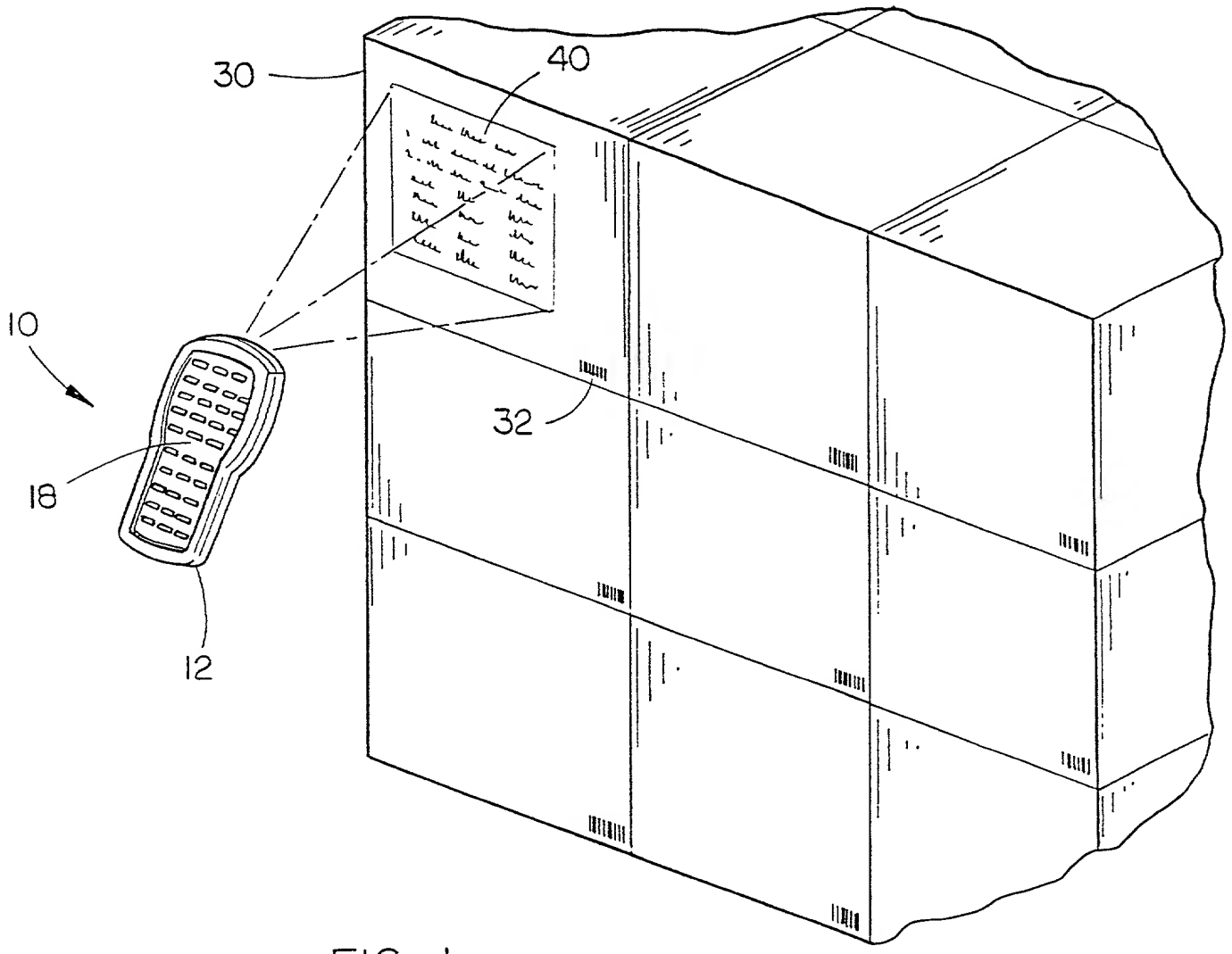

FIG. 1

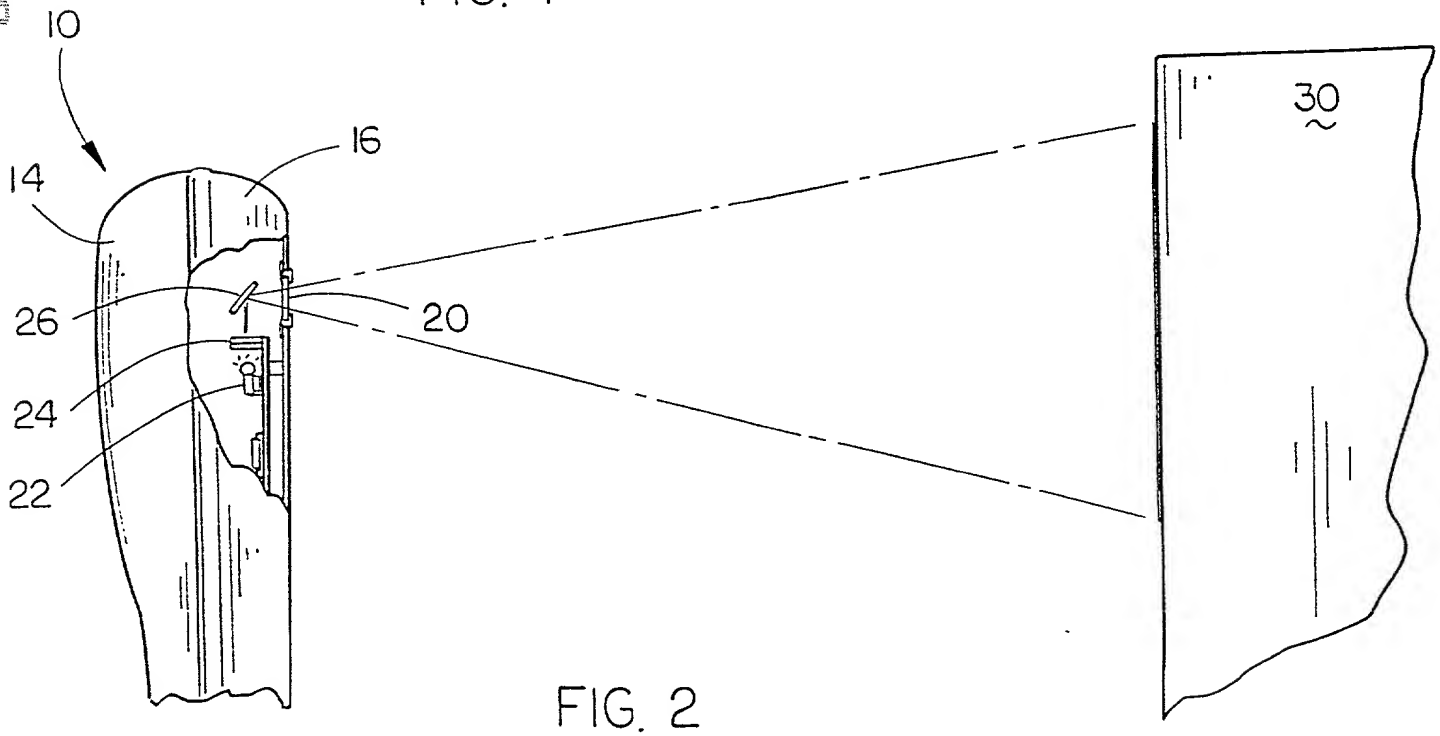

FIG. 2

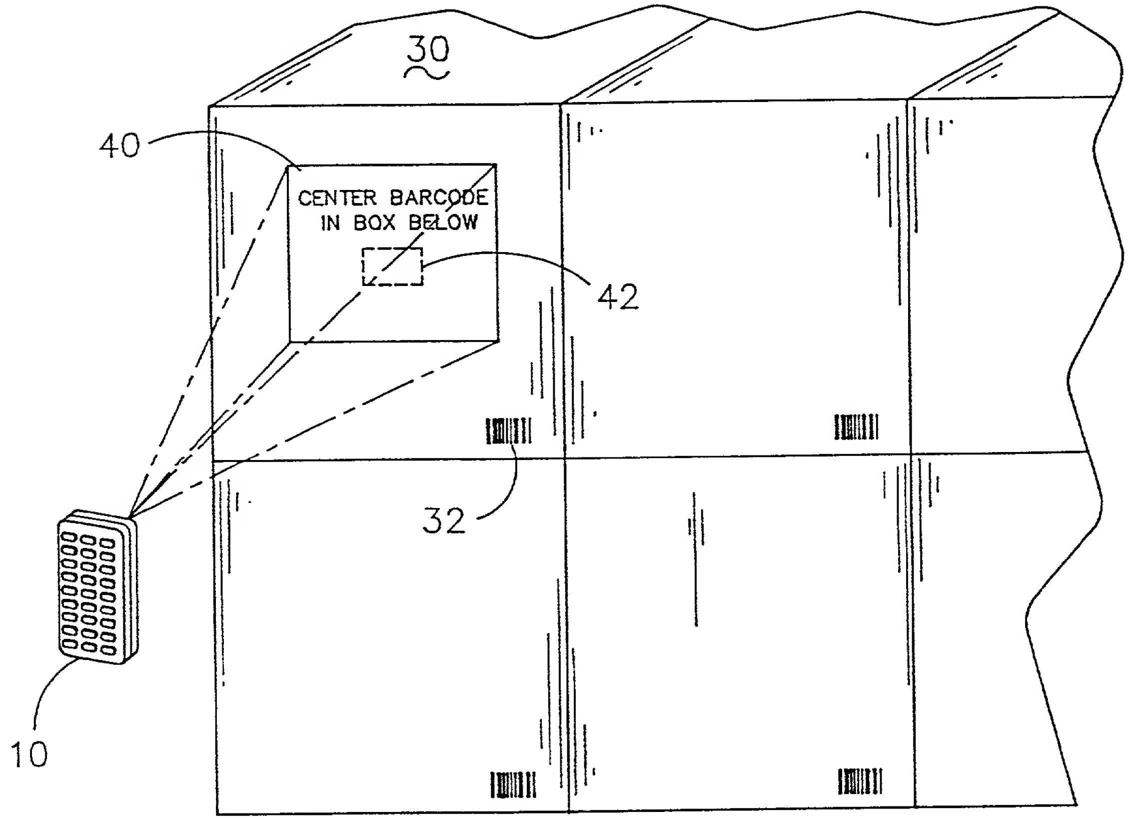
30
40
CENTER BARCODE
IN BOX BELOW
42
32
10

FIG. 3A

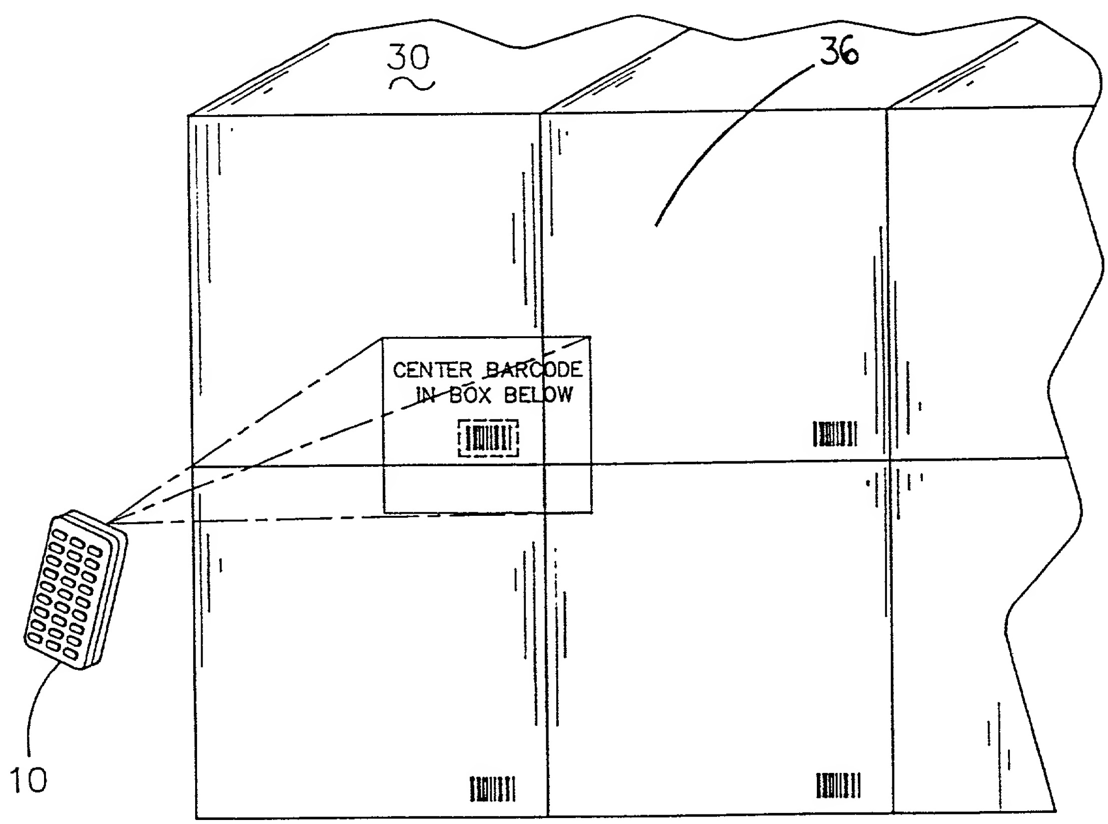
30
36
CENTER BARCODE
IN BOX BELOW
10

FIG. 3B

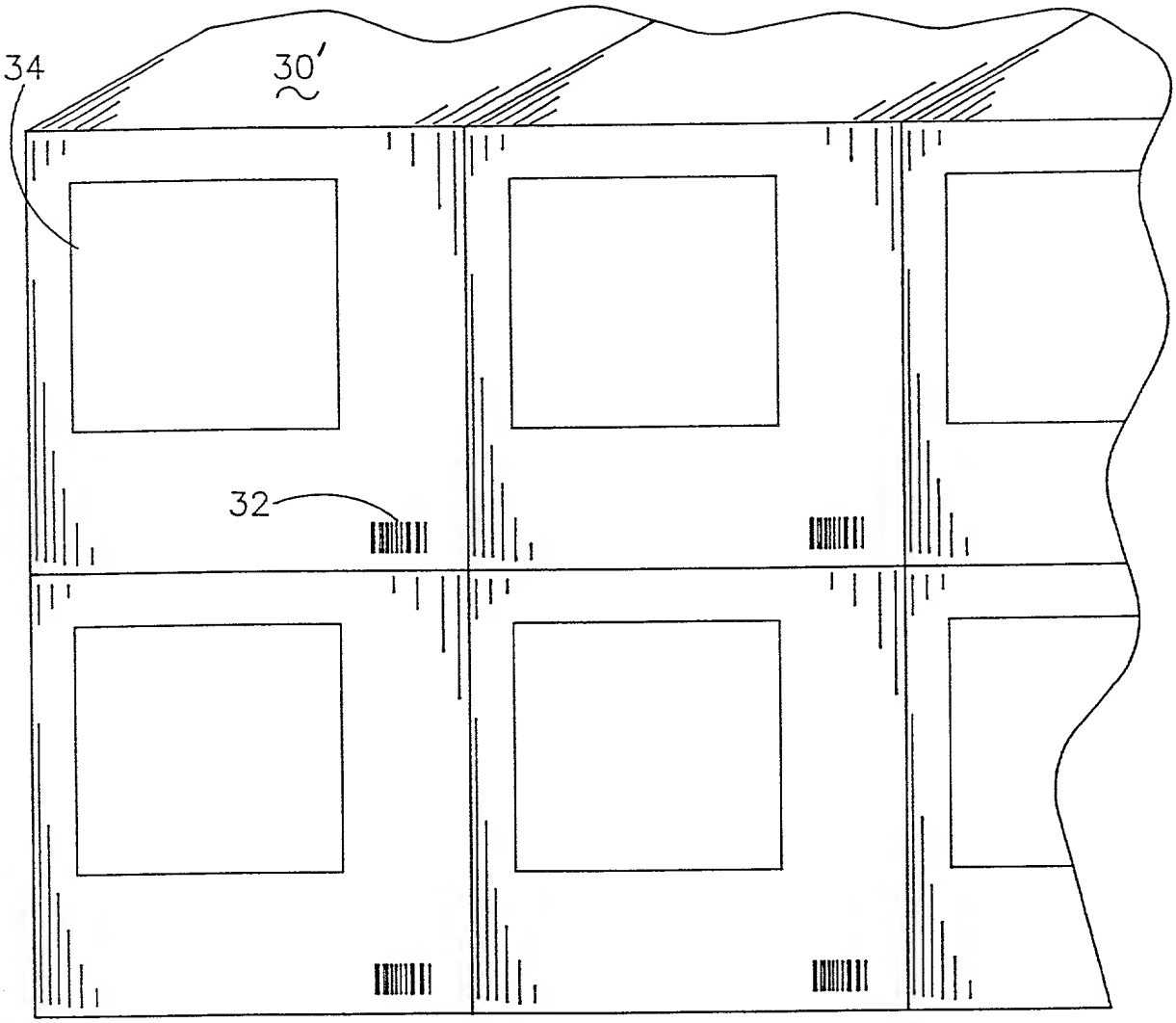

FIG. 4

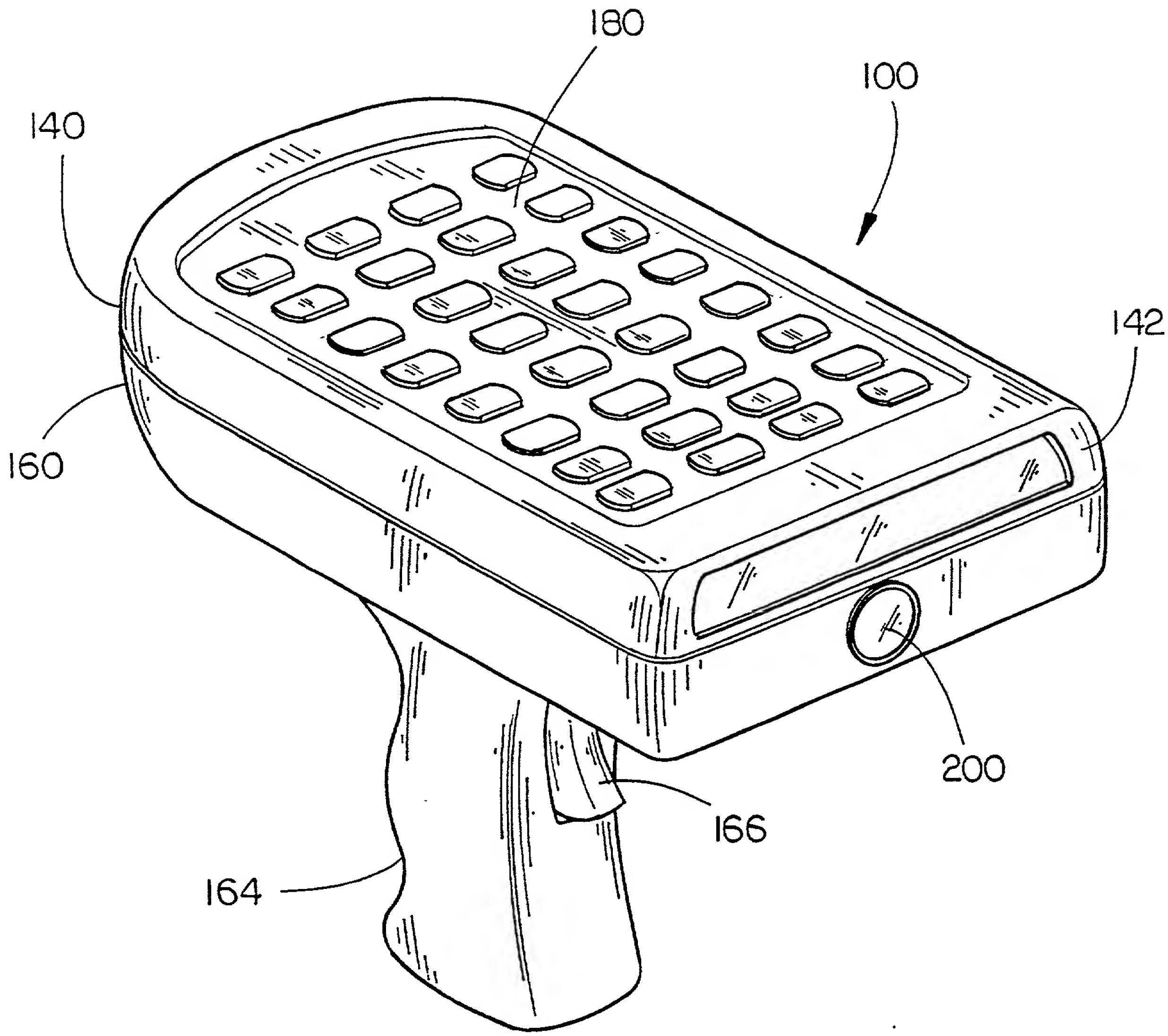

FIG. 5

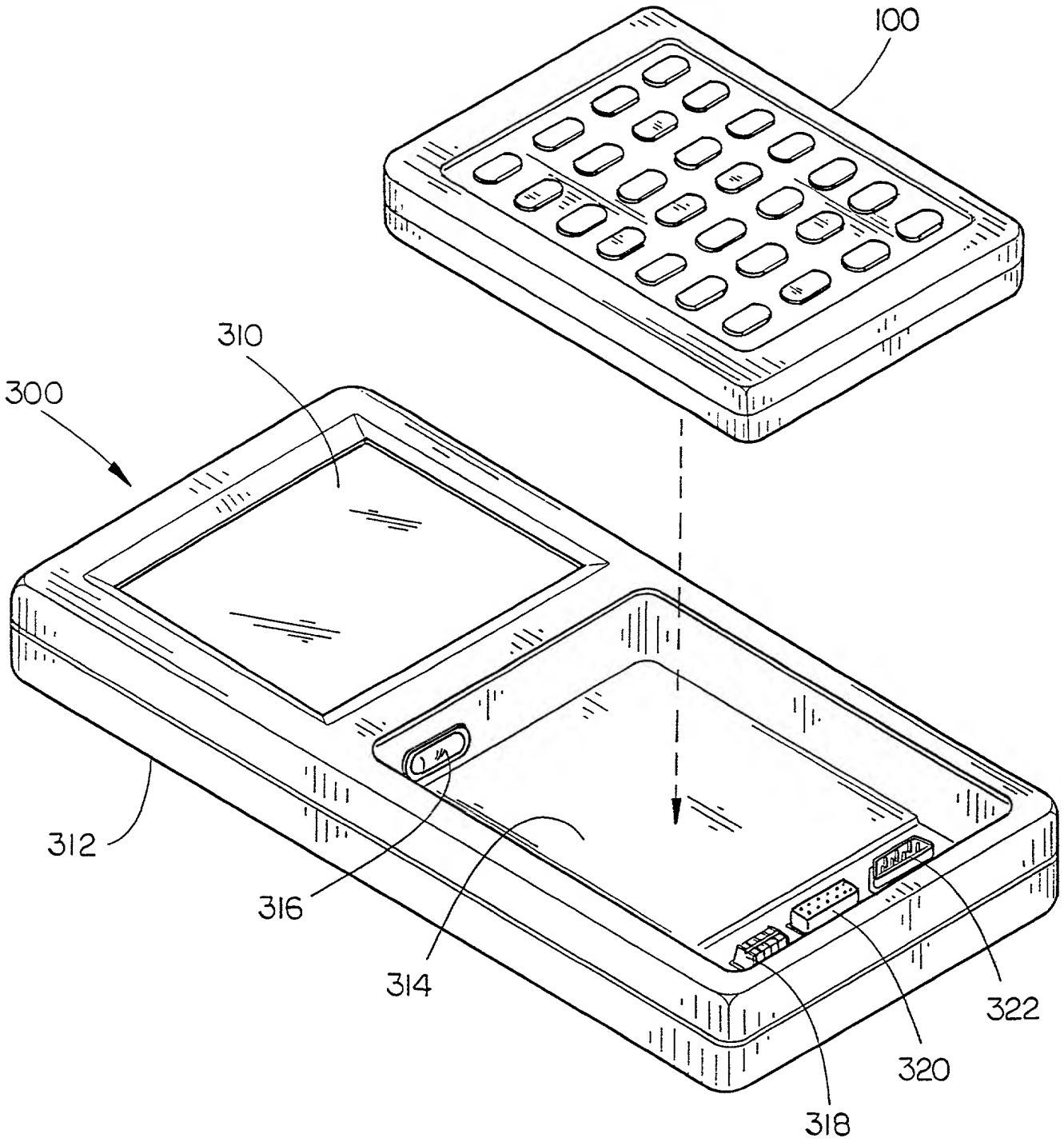

FIG. 6